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ELEMENTS OF HANDICRAFT AND DESIGN

ELEMENTS

OF

HANDICRAFT & DESIGN

BY

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87097

WITH ILLUSTRATIONS

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PREFACE

THE first chapter being prefatory and the last summary, a preface is somewhat superfluous; except that I can here thank Mr. A. M. Poynter for the careful accuracy with which he has perfected the all-important illustrations. It may, however, be wise to set it down here also that the following pages are NOT a treatise on carpentry; though as embodying some results of many years' experimenting, personal and vicarious, on the beginnings of handicraft, they may prove a fit introduction to such a treatise.

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CHAPTER I

INTRODUCTORY

GIVEN a workshop fitted with carpenters' benches and a supply more or less adequate of the usual tools for working in wood, how to utilise them for the right education of boyhood, what should be the aim, and what the means to its attainment? This is a problem which confronts a large and increasing number of school-managers and teachers. Nor in saying boyhood would I exclude girlhood, knowing no reason why ready skill of hand and the practical knowledge that comes therewith should be less generally valuable to women than to men, while it is certain that many women possess high natural aptitude for handicraft, and therefore the grammatical masculine in these pages must be taken inclusively; all questions of specialised employment of boys or girls being outside and beyond our present scope, which is occupied with the foundations for an intelligent education of the hand and eye.

As in the case of foundations for a material

edifice, there is usually some soil and untrustworthy substance the removal of which is the first item in the builder's specification, so do we find the ground for our educational foundation cumbered with misconceptions contrary to edification which we can by no means disregard. Perhaps the most serious of these is the idea that it can ever be the function of a general school course wholly or in part to teach a trade. Though a school workshop will usually bear a superficial resemblance to a jobbing carpenter's shop, you cannot at school teach boys to be carpenters or cabinet-makers; and if you could it would be eminently undesirable to select one or more of the countless industries of life for such wholesale artificial cultivation. Special schools there may be, in which workers in wood, as well as others, can supplement the experience of their apprenticeship and gain broader views of their craft and the history and theory of it, but our present concern is with another matter, that is, the teaching of handicraft as an element in general education—what Ruskin speaks of as "a liberal education founded on right handicraft." And as the aim, so will the methods differ from those of a trade shop. The purpose of a shop is to turn out goods, saleable wares of one kind or another; whereas a school aims at turning out better and more capable men and women. The themes and exercises which are the means to a literary education have no immediate marketable value; commercially, they are but spilt ink and spoilt paper. And so with the exercises of the handicraft school; the endeavour to make a sale-

able product of them is likely to proye a great hindrance to the true advantage of the scholars, which lies in pursuing a course designed to train mind and eye and hand to work together, and accustoming them to accurate and patient industry. And the wider the interest of such a course can be made the better; it may open out glimpses of the foundations of physical science and of the economics of industry; encouraging habits of observation, the love of nature, and the perception of form and colour; developing the latent sense of beauty, in which we have been supposed to fall short of other nations, though enough remains of the work of our forefathers to show that no innate defect in the race hinders the production and enjoyment of beautiful things. For we must not forget in matters of education to regard life as well as livelihood; we have to rear up a race capable of taking a brave part in the competitive industry of the world, and at the same time of enjoying the rewards thereof as good citizens of a prosperous state, and to this end we are encouraged by the opinions of the strictest economists to cultivate the higher faculties and emotions in due proportion.

One special advantage handicraft possesses among the means of education is its exceeding definiteness. In other things the child regards its own errors with a large indulgence; such a result to a sum, or such a form of spelling is by the teacher said to be correct, and deviation therefrom leads to a bad mark or a scolding perhaps; but that there is anything in it beyond chance or the caprice of the teacher is not too certain to the

infant mind, and assuredly the child will find nothing laughable in the ridiculous blunders that provoke or amuse his elders. Nor can you ever be entirely sure what meaning, if any, a phrase really conveys to the pupil so long as instruction is confined to words. The workshop, on the other hand, presents the means of translating the abstractions of number, of geometry, and of mechanics, into visible, tangible fact, and a mistake no longer appears as a matter of opinion denoting a bad mark, but is an experience entailing additional trouble and labour to set it right, not easily to be forgotten, and obvious to mind and eye. Thus the slow-witted Seth Bede in George Eliot's story could not but see the mistake, and perforce laugh, for all his vexation, the moment his blunder of framing up the door without first putting in the panels was observed and pointed out; and so with boys and girls; the knowledge that is really a possession comes from observation, by the eyes and finger-tips; and the difficulty of education is to establish clearly and intelligibly the connection of this first-hand experience with the written or spoken word and the printed book.

In the infant school this has long been acknowledged; what is wanted is to carry on the method with children of larger growth. The now well-known Swedish system called Slöjd does this to some extent, but it is narrow in scope, and the teacher who desires to expand the limits of its horizon into something like a liberal education will find himself confronted by the difficulty of providing exercises suitable to the strength and

skill of his pupils, and such as are fitted to advance them in sound principles of construction and taste.

It is easy enough to gain instruction in the right use of ordinary carpenters' tools, and in the nature of the joints most commonly employed in carpentry; and one or two excellent treatises dealing with them are to be had; and then there are compilations and serials from which a variety of information and hints as to sundry kinds of handicraft can be gathered; but all fall short in the matter of design, reflecting on every page the influence of false standards of taste, and eyes ill educated to the perception of shapely form and good colour. Now it is in youth that these perceptions can most surely and easily be cultivated, and in the development of these must be sought the remedy for any such national inferiority in decorative design or execution as is often complained of, rather than in the mere acquiring a knowledge of the history of architectural or ornamental styles, on which so much energy is with more or less necessity spent by professed students of design.

More than anything else it is deficiency in diffused ability to appreciate excellence of form and colour that militates against national success in work to the perfection of which beauty is an essential element. But it is a mistake to suppose that such trained perception is valuable solely to producers of specially decorative wares. There is no hard-and-fast line between mechanical and decorative fitness; to attain either involves the exertion of similar faculties; and since things must

be of some shape and colour, it is plainly desirable that such colour and shape should be good after their kind, so that the work of mankind shall not deface by its ugliness the beauty of surrounding nature. The division of human fabrics into two opposing classes—the one of ugly utilities, and the other of beautiful superfluities—is alike false in theory and practically hurtful to society. It is also contrary to the instinct of all good workmanship; for every skilled worker is dissatisfied with his work till he has made it pleasant to his eyes and conformable to a certain craft ideal, though of course this ideal may often be one which needs improving. At all events, it is plainly undesirable to make the teaching of handicraft the occasion of a new line of division and premature classification of our youth, when one of its chiefest advantages is that it should tend to diminish the clerkly bias of our present system, and to exhibit the pen and pencil, not as the badges of a superior caste, but as implements to be employed in aiding man's life-work in countless ways.

Preferences and specialised ability and disability will, no doubt, early manifest themselves, but there is no need to emphasise such divergences of character into class barriers. The degree to which a pupil should be pressed along any line must depend upon aptitude, but none should be allowed to be ignorant that good work includes both beauty and utility, and that the worth of words lies in the experience they record.

Then, while the workshop will present experience, limited in scale by the resources of the

school and by the skill and strength of the pupils, the principles there taught may be extended to larger and more complex work in the drawing-school and yet wider views of theory and history by verbal teaching.

In education, as in after life, the incidental advantages of any course are often among the most valuable of its results; for instance, the pursuit of excellence in sports and games is usually found to be a better road to physical health than any course of gymnastics specially devised to that end, for indeed healthy pleasure is the best of stimulants, the safest of medicines. It is well that a man should find pleasure in his work, and when the men sing over it the manager knows that all goes smoothly; and it is just the sense of rightness, of well-employed dexterity, the nicety of perfection, and the delicate finish of detail, making the fabric seemly to the eye and touch, that give the sense of pleasure in the work and make song possible. But the workshop may be made an introduction to a less popular virtue than tunefulness, and that without naming it by name: well-ordered thrift. A place for everything, and everything in its place, a use for everything, and everything ready for its use, should about sum up the whole economic philosophy of the workshop teacher. What eye, accustomed to the tidiness of a well-ordered factory, has not been grieved, in the enjoyment of his country holiday, by the sight of machines wrecked for want of a bolt, or rotting for want of a coat of paint or a shed to cover them, and the fertilising liquors of the farmyard wasted in enriching the nettles of

the roadside ditch? Nor would like instances be far to seek in an urban district.

Now the school workshop cannot be run at all without practical and orderly thrift, not the "spoil the ship for a ha'porth of tar" sort of thrift, but the "stitch in time, everything in its place, ready for use" sort of thrift, that grudges nothing to use but anything to waste; and the teacher that turns out pupils with the habit of careful use and tidy storage will assuredly deserve well of his country.

When one forsakes generalities and comes to consider in detail what work we are to set our pupils to, we are met by a serious difficulty. By the nature of things the material we must work in will be chiefly wood, and as in popular parlance workers in wood are termed carpenters, a handicraft school is pretty sure to be often mistaken for a carpentry school, and criticised, either because it teaches carpentry or because it cannot teach carpentry, according to the prejudices of the critic. The answer to all this is that there is a multitude of trades all working in wood, as shipwrights, cartwrights, turners, cabinet-makers, and the rest, none of which can be taught at school, but that the rudimentary use of the hammer, saw, and file, and a few edge tools, can be taught along with a deal of common-sense science, and the understanding of drawings or diagrams, all of which go to make up a certain handiness which lies at the root of excellence in all trades, and is of incalculable value in any walk of life. And the better to carry out this view it is most desirable to add to the ordinary list of carpenters' tools, not merely the knife and rasp, as

in the Swedish Slöjd, but a few tools for carving and for working sheet-metal, together with materials for painting, staining, and varnishing, and by thus doing we shall add immensely to the educational value of our course, and at the same time the outlay for establishing a workshop for a given number of pupils will be less on this extended system than where the course is severely confined to bare rudimentary exercises in joinery.

The differing circumstances of particular schools, personal, local, or financial, must determine the extent to which it may be practicable to vary and extend the range of work practised in any case; our present purpose is to present a wide view of the possibilities and tendencies of elementary handicraft training; to show how each lesson, like a story in the *Arabian Nights*, must be regarded as an experience, leading on necessarily to future experiences and questionings; no lesson to be left behind as a tale that is told, but each ending with a suggestion of things beyond and around, connected in innumerable ways with the mass of practical science and the facts of life. And so no attempt will here be made to mark out and define a rigid course; but it is hoped that suggestions and examples are here collected sufficient to provide material for a very great variety of courses of work suited to many different grades of school, and that the teacher or school-manager will find among them what suits his own bent and the physical and mental capacity of his pupils, and is capable of accomplishment with the resources at command; and, moreover, that he will find therein a key to the further

development of such exercises in the explanations given of various influences, mechanical, tasteful, or historical, which go to the making of a design. How much of these explanations, the theory of design in embryo, is to be passed on to the pupil, and whether he dwells more on considerations of mechanics or of appearance, is for the teacher to judge; much depends on his own training and natural sympathies; for he is most likely to evoke intelligence in fields where he himself has understanding, and it is of small importance whether one is led to a perception of workmanlike execution, chiefly by considerations of mechanical fitness or by the sense of beauty, provided neither is wholly shut out from view.

But in any case systematic neatness and accuracy must be insisted on. Speed, which is of such primary importance in the workshop, is the result of a habit of doing everything with instant and decisive accuracy, combined with an ever ready alertness of mind and body; and to secure this without falling aside either into haste or slowness should be one of the main ends of school discipline. And therefore, if for no other reason, students should be taught to keep a record of the time taken by each piece of work, and, if possible, any time lost through blunders or inaccuracy should be noted. All material issued should be debited to the job on hand in a notebook kept by and for each pupil; and further, in case any part of the work is, as may occasionally be advisable, done by one boy for another, the time or materials borrowed must be duly debited and credited. For it is plainly desirable to give

the young hand an actual interest in his production, either directly, or by exchange of labour; though, indeed, it is not desirable to allow him the gross product without deduction for material, for plant, and for establishment charges. It is needless to enlarge upon the possible importance of such elementary glimpses of the economics of production, which may well take rank beside the acknowledged agencies for promoting juvenile thrift; and though no near approach to realising this portion of the factory ideal can safely be made in an elementary school workshop, it is well that a judicious hint be given to the industrial tyro that factory expenses have to be met out of the product.

It is to be hoped, however, that the practice of handicraft, for its own sake, and for the sake of possessing the product, will not stop at the elementary school. That down to a comparatively recent period the more prosperous among our villages and country towns teemed with furniture of considerable merit, the outcome of local industry and traditional skill, is a fact of which dealers in old furniture have been but too well aware; and that this skill and taste are not dead, but merely dormant, and may reawaken under favouring circumstances, is sufficiently shown by the success which has in many districts attended the efforts of the Home Arts and Industries Association; and we may further hope that by-and-by local associations, analogous to their village horticultural societies, will arise to do for other industries what has in so many neighbourhoods been done for the encourage-

ment of cottage-gardening by friendly rivalry. Here would be work for a neighbourhood guild which might do much for local life, and many a man, when employment is slack, or stress of weather prevents outdoor work or spoils an outdoor holiday, might do worse than employ his time and exercise his brains in working for the bettering of his home.

But are we not wandering from our subject? Nay, for there are many sorts of schools of handicraft, and we must be careful how we exclude the possibilities of development from our scope, knowing that the teacher whose view extends no further than the precise course laid down for his own pupils, cannot readily hide from them the inadequacy of his learning, and how then shall he hold their respect? Some schools there are too, and these not the least efficient, where teacher and taught are one, and to such also these pages may be useful; and in any case is it not in the glimpses of what lies beyond the immediate subject, and in its relations thereto, that most of the vitality of teaching always depends?

CHAPTER II

DRAWING

No teaching of handicraft is likely to be of very real advantage which is not supported by a perfectly co-ordinated drawing-school; co-ordinated rather than sub-ordinated, for there is no reason for limiting school-drawing to the position of being the language of handicraft; supremely important though that function assuredly is, seeing that scarcely any mechanical work is set about without some preliminary drawing, however rough and unfinished, to define its form and proportions. The teaching of drawing is not at present, however, our immediate concern, but rather the connection between the workshop and the drawing-school as the drawing-office of our school-factory; and a very important part of a factory it is, both in and out of school; for unless the young craftsman is taught to make, or at least to take tracings of, the drawings for all his work, and to work from them and to them, the most valuable educational means will have been neglected. But for the moment let us in imagination leave the school to glance round the drawing-office of a grown-up establishment. Let us suppose that an order has been received for

a chest of drawers, with a dwarf cupboard above it—a very ordinary piece of furniture,—and that the instructions given with the order are that it is to stand in a space 3′ 6″ wide,[1] the room being 9′ 6″ high; this, and the particular kind of wood of which it is to be made, would likely enough be all the information given in such a case, the rest the draughtsman would have to supply from his own knowledge or from drawings and measurements of similar pieces. How, then, does he set about his work? He has before him a blank sheet of paper pinned down upon a drawing-board; he has a T square and set square—in short, the usual apparatus for geometrical drawing; such are his tools and his materials; his task is to make a diagram which shall convey to the craftsman who works from it the exact size and shape in every part of the piece of furniture required; he has to make, in other words, a *scale drawing* of the work. In this case a convenient scale would be $\frac{1}{8}$ of the full size, otherwise known as $1\frac{1}{2}$ inches to the foot—that is to say, where the cabinet-maker will use a rule divided into feet and inches, the draughtsman will use a rule divided into spaces of $1\frac{1}{2}$ inches representing the feet, and of $\frac{1}{8}$ inch representing the inches of the full-sized rule; so that when the drawing is done it is easy to measure off all the dimensions with the miniature rule, or scale as it is called, and so accurately determine the size of every portion of the work. How will he convert the blank sheet of paper into a serviceable diagram, a *working drawing?* Well, probably he will begin by mak-

[1] Workshop notation for 3 feet 6 inches.

ing a rough sketch of what is wanted on the margin of the paper. It is a perfectly familiar form; the best way of making every part is pretty well settled, and all that the designer has to do is to determine the best proportions of the several parts. Having got them to his liking on the rough sketch he will next mark on it in figures the chief dimensions. The width has to be less than 3 feet 6 inches, we know, so we will make the carcase 3 feet 3 inches across, allowing 3 inches for the projecting base and cornice; 1 foot 8 inches is the usual depth of a chest of drawers, and the total height of such an one as this would be rather over 6 feet. Then we remember that drawers become less convenient above a height of about 4 feet 6 inches from the floor, which suggests that as the point at which they should give place to the cupboard. Then, if we take 9 inches as the height of the plinth or base, we shall get the bottom drawer handy and also leave space to get a brush underneath to sweep out the dust. Then there is the thickness of the wood of which it is to be made,

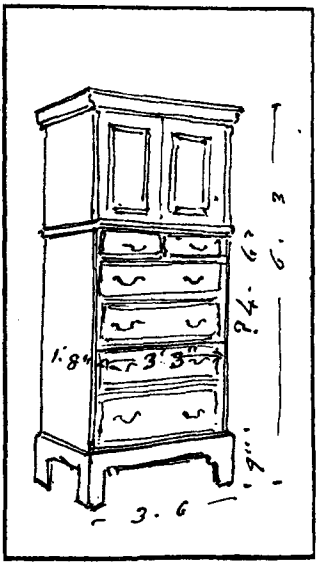

FIG. 1.

which, in the case of any such wood as mahogany, may be what cabinet-makers describe as "inch stuff," which will be about $\frac{7}{8}$ inch thick when planed. Now we can begin our working drawing; first we draw a horizontal line for the floor-line, we then take the scale and mark off two points 3 feet 3 inches apart (actually $\frac{39}{8}$ feet $= 4\frac{7}{8}$ inches), and then using the set square we draw two lines upright about 6 feet high through these two points. All these first lines are to be drawn with a very sharply-pointed pencil and very lightly touched, as much of them will have to be rubbed out before we are done. Then we draw two more lines inside these to correspond with the thickness of the wood, $\frac{7}{8}$ of an inch, and a cross line at 9 inches for the top of the plinth, and another at 6 feet for the top, and one at 4 feet 6 inches for the bottom of the cupboard; then we put a faint line for the centre line of the cupboard doors and the division between the two short top drawers, and very lightly indicate the shaping of the base and the cornice. But by this time we have got quite far enough to see that the dimensions we have guessed at will not quite do—that the drawer part and the cupboard part are not nicely proportioned one to the other—so we must alter them, trying various positions till they look right, and by the time we are satisfied we have got the top of the drawers down to 4 feet, and the cornice up to 6 feet 4 inches; then the rest of the task is plain sailing with such a commonplace design as this, provided of course that we know our business. Throughout, be it observed, nothing which can be called invention has been brought into play—all

the construction has been taken for granted; the grooves, the dovetails, the runners, and blocks being left to the practised skill and judgment of the workman; but it might easily happen in the case of a

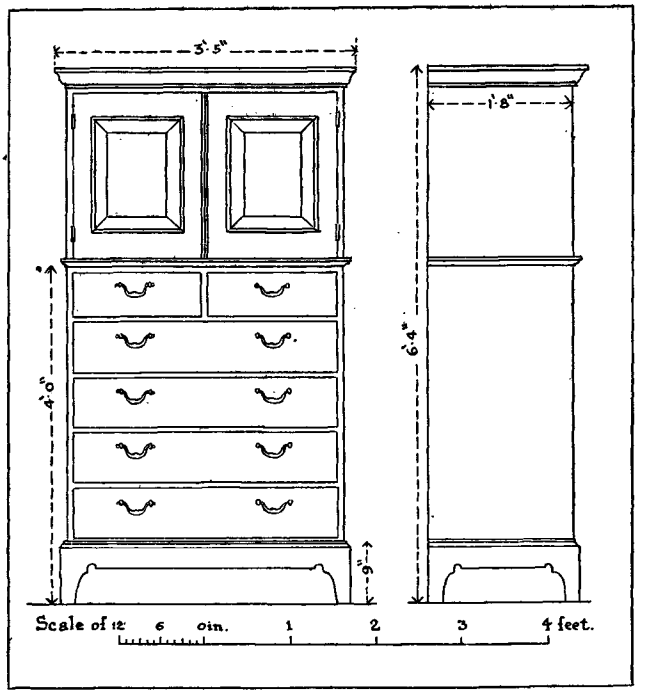

FIG. 2.

less hackneyed subject that very careful structural details would have to be given; nor is the designer worth his salt who lacks a keen appreciation of constructional necessities. Nevertheless, as a general rule, neither structural nor ornamental invention is

called for; the designer has to select from a narrow choice of possible forms and modes of construction, all well known, and to arrange the most pleasing proportion of parts, the absolute sizes of which are mostly practically determined for him within narrow limits; and yet within these limits a man who thinks for himself will find room to exercise a certain originality and to display the essential qualities of a capable designer. Of course, if we were going to set our young hands to make such a chest as we have been considering, we should have to furnish much more complete details of construction; but as it is far beyond our scope, we need say no more than that a full account of the construction of such furniture may be found in *Every Man his own Mechanic*, and proceed with an endeavour to form some idea of the stages by which the draughtsman achieved expertness, tracing back the steps of his progress till we come to a stage comparable in some degree with school possibilities.

Just one stage earlier, in the position of a subordinate draughtsman, one would find that instead of evolving the whole design, beginning from the first sketch out of his own resources, he would be given the rough sketch, and very probably some working drawing differing but little from what is required, and therewith a general idea of the modifications necessary, and from these he would complete his drawing, to be corrected in due course by his chief. At a still earlier stage he might be put to ink in or tint a drawing already finished in pencil, or to copy a drawing on a different scale,

till we reach the first stage of all, making a simple copy by tracing or otherwise of a finished drawing.

And it is to this that the beginner must be set; a drawing having been selected which can afterwards be worked from in the shop, will be pinned down on a board with a sheet of tracing paper over it, and with the aid of a T square and set square an accurate copy can be produced, following thus the regular workshop practice, whereby original drawings are carefully kept in the office, and only traced copies are subjected to the wear and tear of workshop usage.

The teaching of drawing, however, does not come within our present scope, which is merely to indicate the proper relation between the drawing office and the shop. It is obvious that any likely apportionment of school hours will allow of many more drawings being made than can be worked from in the shop, but the execution of even a few works from the plans gives a reality to geometrical drawing which is a great relief to the overtasked imagination, and a most valuable antidote to parrot learning. While he is carrying out in the workshop his earliest drawings, a pupil will have ample time to trace other and more advanced designs, passing on in due course to more difficult exercises, such as reproducing a drawing on a larger or smaller scale by the aid of compasses and the like. But the most valuable lesson of all comes to the more practised student when he essays to adapt some familiar design to the requirements of his own home. Meantime other

forms of drawing, as ordinarily taught, need not be neglected; the additional interest derived from the connection with the workshop is all gain, interfering with none of the acknowledged merits of drawing regarded as an educational means. These are now generally admitted, and there is scarcely any calling in which a quick eye for lines and contours will not prove of immense advantage to a man in his daily work, though but few recognise the extent to which considerations of beauty of line enter into what are ordinarily regarded as purely mechanical works. The engineer planning some stupendous work which aims at endurance without limit, the ploughman laying out the furrows of the season's seed-bed, nay, the salesman tidily arranging a brown paper parcel which is likely to be opened and scattered an hour hence, are all, together with countless other workers, guided not merely by considerations of expediency, but just as much by a sense of form, which no logic can distinguish from that sense and perception by which we find enjoyment in those great achievements of painting and architecture, which, among the works of man, we most usually think of as things of beauty. Further, the lines and forms which we use in daily work are, for the most part, selected, consciously or unconsciously, from those which we see in nature; and in the habit of observing nature, the forms of vegetation and of animal life, the sweep of sea and land around us, is to be sought the foundation of all vivid appreciation of form,—a habit most easily cultivated by drawing, but vivified and made solid by workshop

practice well directed. And while this is true of constructive work, it applies with tenfold force to ornament, that added grace which the finest craftsmanship always desires to put upon its handiwork. Not that, even in ornamental design, is direct imitation of nature general; much ornament is merely the outcome of a kind of playing with one's material, whittling the edges of a stick and the like; and the treatment even of that which is to a greater or less extent imitative of nature is determined as much by what is called tradition as by direct study of nature; nevertheless, good ornament is impossible except at the hands of men who add to their knowledge of traditional treatment, which they derive from their predecessors and fellows, a fresh appreciation of the beauty of nature, and a sympathetic familiarity with vital forms of growth; so that it is important to make sure that any study of ornament which may form part of a school course of drawing should be supplemented by a concurrent study of nature, as far as possible at first hand. A word of warning may be uttered against the practice, not unknown in schools, of making finished drawings of carved or modelled ornament; the rough sketch followed by the clay model is the procedure of the workshop and should be that of the school.

Similarly, painted decoration should be studied with the brush and not with the point. A useful practice would be found in the drawing and cutting of stencils; in this and in clay modelling may be sought another bridge between the teaching of drawing and the workshop. Finally, it may be

hoped that not infrequently drawing may, in the case of the older pupils, be a means of giving a first glimpse of the meaning of architecture and painting, as it has been shown to be an introduction to practical construction.

CHAPTER III

BEGINNINGS OF HANDICRAFT

THE beginnings of handicraft now make an excellent start in the kindergarten, with its numerous interesting operations with scissors and paste, needle and thread, plaiting with paper or straw or rush, all which, with the pretty craft of basket-weaving, we may safely leave to be developed by the ingenious hands which have already done so much to improve educational methods. But when we come to a more advanced stage, and have to deal with an age capable of handling the lighter sort of carpenters' tools, such guidance fails us. There are, it is true, a sufficiency of books giving an adequate account of the nature and use of the several tools, which might prove excellent introductions to the joiners' trade, and though this is not what we want, some such books should be in the possession of the teacher of handicraft. The Swedish Slöjd system, however, comes much nearer what is required, and though it by no means covers the whole ground, it supplies many exercises which can be used to supplement those given here, while we can scarcely do better than begin by taking a

hint from their course in proposing for a first exercise the preparation of sticks for the flower-garden, or at least for the flower-pot. Those commonly sold are split from straight-grained wood and roughly rounded, but from the point of view of handicraft training we regard the task as a first exercise in the use of the saw and the plane,—the problem being, to cut a strip off the edge of a thin board and plane it up smooth and foursquare. When we can do this with some approach to accuracy we shall be able to get further instruction out of such strips, but our first attempts ought to make capital flower-sticks. The board should be about $\frac{3}{8}$ inch thick, and having planed one edge we take a gauge and mark off a strip $\frac{3}{8}$ inch wide and say 16 inches long, then saw it off and plane the three rough sides as smooth and square as we can—the result, if we are fairly successful, being a stick about $\frac{1}{4}$ inch square. If, then, we point one end and round off the edges with a paring chisel, or perhaps more easily with a rasp and coarse glass-paper, we shall have a very serviceable stick for a pot of hyacinths, the appearance of which we may greatly improve with a coat of green paint, at the same time making it much more durable. But I have seen much prettier sticks than this, the recollection of which suggests a first lesson in ornament. Before rounding off the angles mark off about 3 inches of one end and leave that square; then shave off the angles, reducing the square to an octagon, and as you approach the other or pointed end, reduce the octagon in turn to a rounded form; then with a sharp knife

whittle the square end,—a process which should give the keenest pleasure to a properly constituted mind. There are four obvious patterns in which

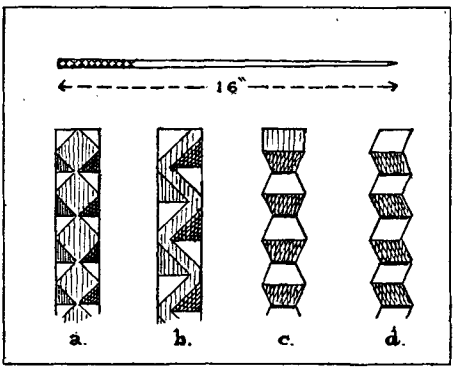

FIG. 3.

to arrange the notches, of which that marked *b* is perhaps the prettiest; in two the faces are whittled, in the other two the angles of the stick. From the simple sticks we pass on to the little frames so commonly used for musk and other creeping plants, consisting of three uprights, with two or more rails nailed across them; little need be said about the making of them except that, instead of square sticks, you want flat strips; $\frac{1}{4}$ inch strips cut from a $\frac{3}{4}$ inch board will do well enough; plane them smoothly, point the bottom ends, do some little notching to the other ends, and some six tacks will do the rest; then you may paint them green and pick out the tops with white and red.

But simple as it all is, there is a nice little bit of engineering to be noticed about this common-

place frame. If the pieces I just now called uprights had been really all three uprights instead of the two outside sticks slanting outwards as they do, the little framework would have been unstable; every joint would have turned on its pin like the parts of a parallel ruler;[1] and similarly, if there were but two uprights, the thing would not keep in shape, as you can see by trying before you nail on the third little post; or better still, let us make one without the third upright and see what means there are of making it preserve its figure, besides the way we already know of putting in the central upright. Well, we might put two nails at each joint, or we might halve the pieces together at the joints; either of these plans would make the joints rigid instead of being merely pivots, as they were in the first case. We can also do it by nailing a piece slantingly across, and we can do it most effectively with only three pieces by making the frame a triangle. So here are some facts which may appear trifling and unimportant enough in this instance, but which, nevertheless, lie at the foundation of the science of mechanics; that is to say, in making a framework of any size,

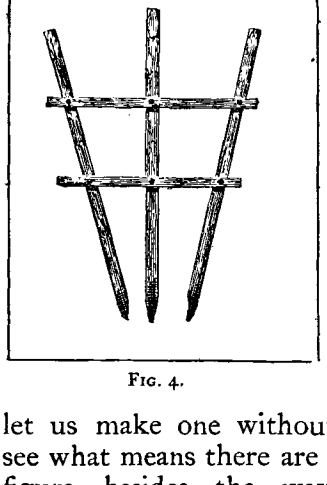

FIG. 4.

[1] See also Fig. 15, p. 42.

small or great, you have a choice between two ways of constraining it to keep its shape: one is by making the joints very strong and rigid; the other is by choosing a form incapable of alteration. We have found two such forms; the last is an important one, namely, the triangle. You know that among the first things you learn in geometry

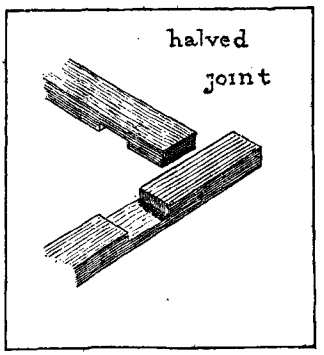

FIG. 5.

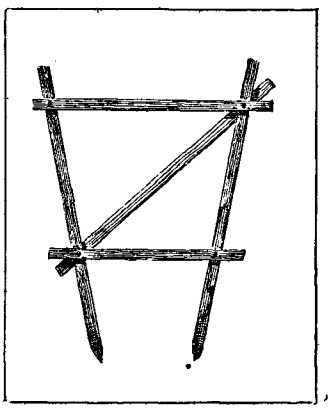

FIG. 6.

is, that if you are told the length of the three sides of a triangle, that is all the information you need have about its shape and size; but that when you have four sides, there are a great many shapes that can be made with the same lines or lengths; and in making these frames we find that what is true of the lines on the paper is true also of our bits of stick, and that when we nailed the piece across in Fig. 6, the four-sided frame which was free to change its shape so that the

angles at the corner would be different, was turned into two triangles which cannot change their shape as long as the lengths of the sides are unaltered. So next time you see building going

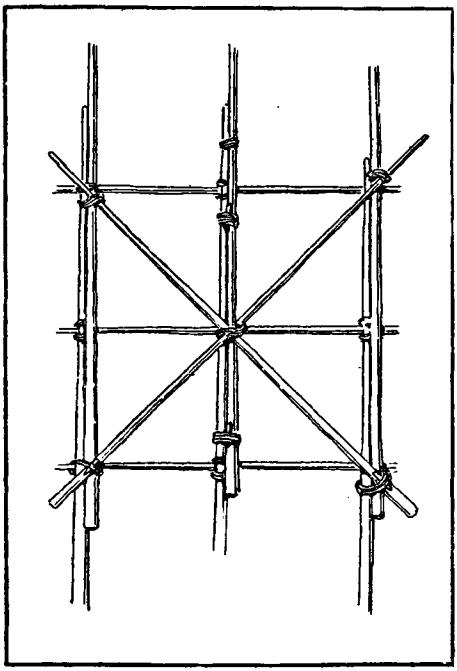

FIG. 7.

on you will understand why the scaffold has two poles lashed across slanting-ways, and that it is just like the scaffold we have been making for plants to climb, only that it is large and tied together with rope instead of being nailed at the joints;

these slanting pieces are called braces and prevent the scaffold from collapsing like a parallel ruler, or, as engineers say, prevent it from being racked. But to return to our flowers. You know the look of a carnation, with its heavy head and thin grayish stalk, a flower that always wants a stick

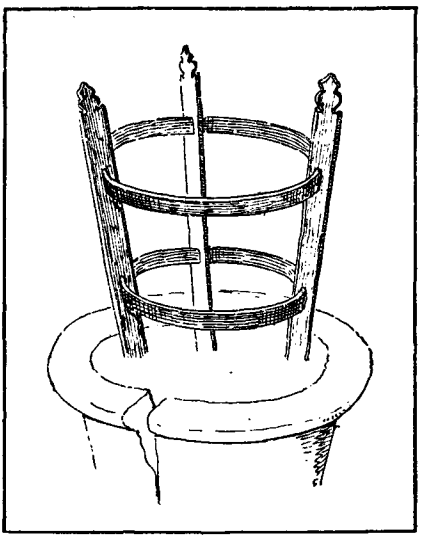

FIG. 8.

to make it stand up handsomely. Now in the National Gallery in London there is a little Dutch picture perhaps three hundred years old, for the Dutch were always clever gardeners, and in the picture is a pot of carnations which are supported by a very pretty little arrangement of a sort which seems to have gone out of use, but it is so good

that I hope we may get credit for reviving it. Common plasterers' laths will be the best material of which to make the uprights, and the sides would no doubt most easily be made of osier passed through centre-bit holes in the post; but by making two holes instead of one and cutting out the wood between them you can use a flat rail, the edges of which have been rounded off. Ordinary wooden fencing, such as you see by the side of a railway, is put together just in this way, and it deserves notice as an elementary instance of the use of a *mortice*, which is the name given to a hole made in one part of any structure for another part to fit into, the part that fits into the mortice being called the tenon; by-and-by we shall meet with more difficult mortices than this, but for the present we may be content with a mere notice of the name. Any difficulty in bending the rail into a hoop may be got over by steaming the wood, or even by soaking in hot water, a fact which it is well to take note of. Similar laths also seem admirably adapted for making small pieces of trellis-work for climbing plants and for use as screens in the garden, and they

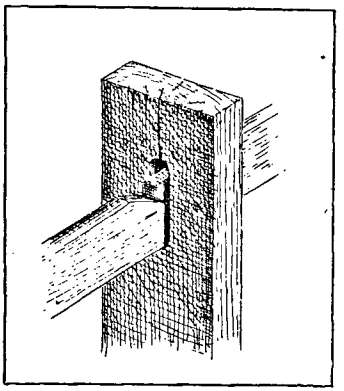

FIG. 9.

are also commonly used for cutting into the little labels on which the names of fruit-trees are written, and those which are used to mark the places where different sorts of seeds have been sown; they are usually given a coat of white paint, the names being written in pencil before the paint is quite dry and hard.

But perhaps it is now time to try our hand at making a box,—not a very difficult thing it might seem—one consecrated by all tradition as the first essay of the beginner; and yet in the perfect and accurate making of boxes lies the larger part of the craft and mystery of cabinet-making.

Our first box, however, must really be a very simple affair and by no means a piece of cabinet-work, but only a common nailed box, a baby packing-case, in fact, though we shall plane the wood as smoothly as we can. Almost any book on woodwork will give you ample instructions for making such a box; to which I need only add that it is much easier to nail the box together, and makes a stronger job when done, if you cut the ends or short sides out of rather stouter wood than the rest, for it gives you more stuff to drive the points of the nails into and a better bearing for the side-pieces. And it is worth while dwelling a little on this point, and considering the why and the wherefore of it with the aid of some simple experiments. Take two pieces of plank, one thicker than the other, say $\frac{3}{4}$ inch and $\frac{1}{2}$ inch respectively, and having squared off the ends fix them upright in the vice as if ready to nail to them, and try how much easier it is to balance a third piece on the top of the thick than of the thin

piece; and when a piece is placed in position for nailing, notice how much more steadily you can hold it in place on the thicker piece, and then reflect that what applies to the force of your hand applies also to the holding power of the nails, which is exerted to much better advantage in the case of the wider bearing. It is by the habit of noticing such matters that the mechanical instinct is cultivated and workmanship is elevated from mere rule of thumb to manly reasonableness. Though to make a box tidily is by no means the easiest possible task, yet it is one that is rightly set before the beginner at an early stage, for the reason that, however rough his achievement, so long as it will hold together it is of some utility; if it will not serve as a nail-box, at least it will do to fill with earth and grow seeds in. It must never be forgotten that mere painstaking will not ensure any great degree of accuracy at the first start; it requires time to train the muscles to perform with certainty the series of motions which go to the accomplishment even of so simple a task as that of cutting six pieces of wood to rectangular forms of given dimensions with any sort of accuracy, and therefore, before we proceed to attempt the production of anything more sightly in the shape of a box, we will turn our attention to certain tasks which do not involve the correct formation of so many right angles, but which will, nevertheless, put us in possession of some interesting facts as to the nature of things. A bracket or small shelf is a thing which is frequently useful, and there are many kinds which are sufficiently easy to make. There is one of a sort which is convenient for sup-

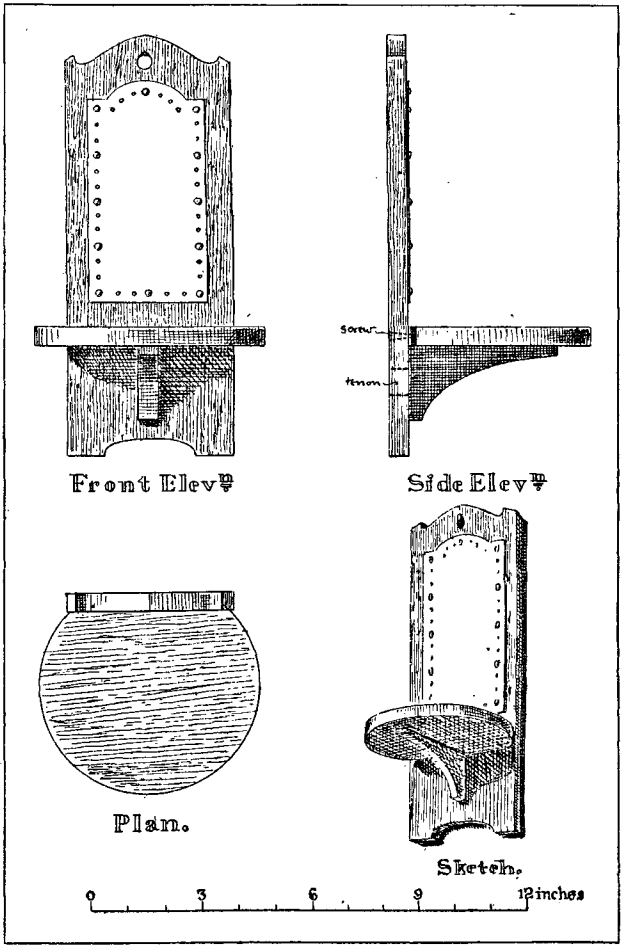

FIG. 10.

porting a small lamp or a vase of flowers, and even if we fail to make a tidy job of it, a coat of paint will make it serviceable to carry a flower-pot out of doors. It is made of wood about $\frac{1}{2}$ inch thick, and the curved parts should be cut with a fret saw. There are three pieces: the back, the shelf, and the supporting bracket, which has a projecting tenon fitting into a mortice cut through the back. To cut the mortice, make a round hole with a centre-bit and then square it with a chisel. Next glue the tenon in place, wedging it up tightly; lastly, you fix the shelf with long fine screws put through the back piece from behind, and join the shelf to the bracket by glue and fine brads or wire nails. Presuming that we have so far accomplished our task in a manner worthy of further attention, we have a choice of various ways of giving it a pretty finish. We may carve it; we may paint it, with or without pattern-work; or we may stain and polish it; about all of which processes we shall have more to say presently, but the bracket in the sketch being intended for a lamp has been stained and varnished, and a little reflector cut out of a waste scrap of tin, nicely polished up, has been nailed on it with a row of brass-headed tacks. This then is one way of making a small bracket or hanging shelf, and if it be well executed I doubt not you will find it a pleasing one; let us, therefore, ask a few questions as to reasons for its shape. And, first, why is that little three-cornered piece put under the shelf? Well, you remember in nailing the box that the thicker the piece we were nailing into the steadier the other side was, and so with

this shelf: if we took a very thick piece of wood we should be able to screw it to the back strongly enough, but it would look a very clumsy job; and yet you can feel with your own hands how very weak the shelf is when only held by the screws, and how firm it is when the job is finished and the little triangle is in its place underneath, so that you see that little piece enables us to make the shelf much more elegantly than we otherwise could. Now I want you to notice one or two things about the wood you have been working in. You have seen the boards as they come into the shop, and have noticed that they are long and comparatively narrow, and you know that that is because they are cut out of the trunks of trees which are tall and more or less slender. Again, you have by this time found out practically for yourselves that the grain of the wood runs lengthways of the board, and that it makes all the difference which way you are cutting it. Now among the scraps look out two pieces 3 or 4 inches long, and not above $\frac{1}{2}$ inch or $\frac{3}{4}$ inch wide and thick, one of which is cut across the grain and the other lengthways; you will find that you can easily snap the one across with your fingers, but that the other is much too strong for you to break; and so you see an additional reason for the little triangle under the shelf, in that it serves to protect the shelf from being broken across with the grain.

Again, why should the back have been made so high? Partly, perhaps, for the sake of appearance, and partly to get room for the little reflector, but more decidedly to diminish the *leverage* with which

weights placed on the shelf tend to draw the nails which fasten the bracket to the wall. Let us make sure that we understand the meaning of this. We take a piece of board, say 12 inches long, and at mid-length we rule a line square across. Similar lines are to be ruled $2\frac{1}{2}$ inches from this centre line on each side, and 1 inch from each end, five in

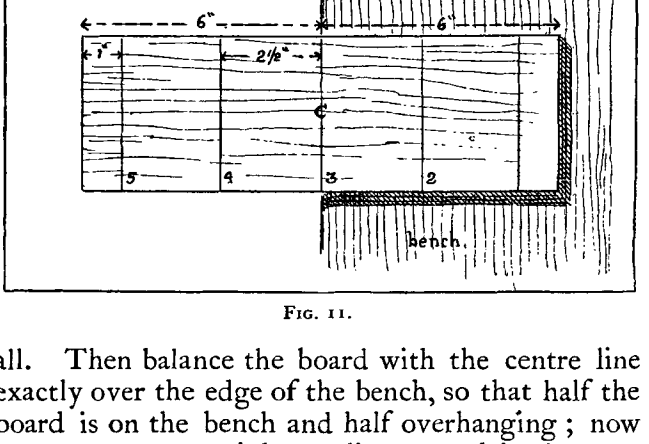

FIG. 11.

all. Then balance the board with the centre line exactly over the edge of the bench, so that half the board is on the bench and half overhanging; now put say a 4 oz. weight on line 1, and having put an equal weight on the overhanging half of the board, slide it gradually outwards; you will find the balance getting less and less secure till it reaches line 5, when it just balances, and the instant it passes beyond, it topples over. Next let us try an 8 oz. weight; with this the same thing happens when line 4 is reached—the least bit beyond, over it goes. But if we put the 8 oz.

weight on line 2, it will support the 4 oz. weight till it reaches line 5,—that is to say, the farther the weight is from the centre the greater its power; if it be twice as far from the centre it will balance twice the weight on the other side; if three times, three times, and so on. You are already practically familiar with this principle, though you may not have noticed how, in riding a see-saw, when you are up in the air you lean back so that the weight of your body is farther from the centre, and the boy at the other end leans forward so that his weight is nearer the centre, and thus his end goes up and yours down, just as the 4 oz. weight did when moved beyond line 5.

This, then, which you have known, or at least felt, ever since you can remember, is the principle of the *lever* in its simplest form; and the principle is the same whether weight or nails or anything else be the resistance. You must not knock nails into the bench, but if you screw a piece of waste wood into the vice you can nail into that and discover for yourself how much more power a nail has when it is driven through at line 1 than at line 2—line 3 being in both cases at the edge on which the piece rocks. Just so in the case of the bracket; the flat piece against the wall is the long arm of the lever, the shelf is the short, and a nail driven through the top has a much better chance of holding it to the wall than if we had made the back shorter or the shelf project more. The wall-piece and the shelf together form a bent lever like the crank of a bell-pull. In all this we have been taking a hint from the old-fashioned tin candle

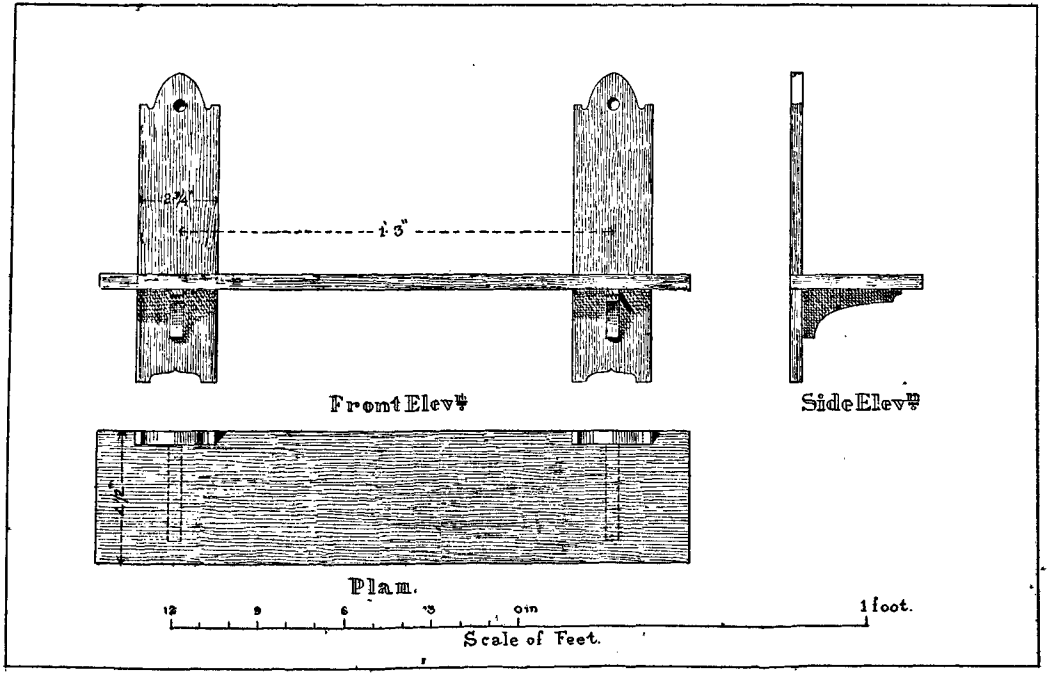

FIG. 12.

sconces which are made of this sort of shape, so as to get a reflector and a smoke-guard, and at the same time to hang securely from a single nail.

Having got these principles well into our heads, we are in a position to design a variety of hanging shelves. If we want a larger shelf we can obtain one quite tidily by using two uprights, as in Fig. 12. To make a bookshelf we can easily lengthen the wall-pieces and add a second shelf; then at each end we shall want an upright in front to keep the books in place. The simplest way of fitting them is to cut their ends thus (Fig. 13), forming tenons which can be passed right through oblong mortices cut in the shelves, leaving projecting ends, against which the little brackets can be fitted. You see that under the top shelf I have put a little piece shaped like an arch, mainly because the arch is a pretty shape, and the thing looks unfinished without it, but also because it helps to keep the work square; for you see it is just two brackets, such as we have used before, put point to point—one serving to fix the shelf square with the wall-piece, and the other to stay the front post in position. But besides keeping things square, these brackets serve another purpose; they act as ledges to stop the shelves from warping. For I must call your attention to another point about a plank of wood which you may not yet have noticed. Besides being weaker across the grain, it also gets narrower as it dries. If you take a small piece of

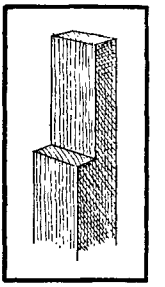

FIG. 13.

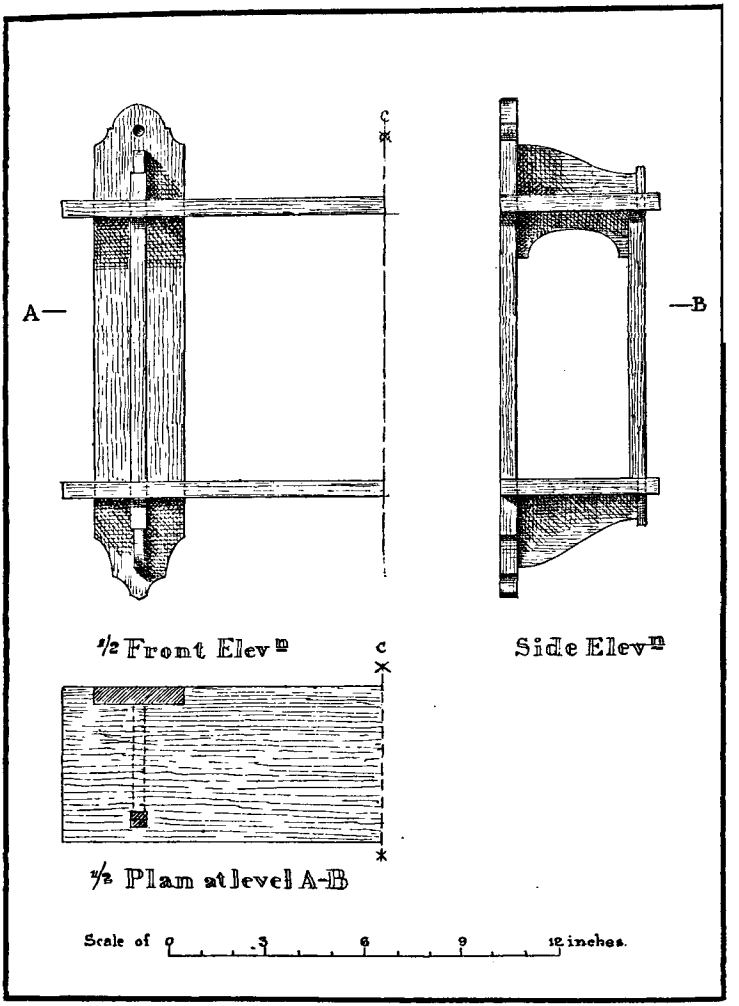
A
C
B
½ Front Elev^n
Side Elev^n
C
½ Plan at level A-B
Scale of 0 3 6 9 12 inches.

FIG. 14.

board and put it close to the stove you will find that it bends round, becoming hollow on the side towards the heat, and rounded on the other; and besides this bending or warping you will find by measuring that it has actually shrunk; the board has become narrower. The length of the piece has not altered; the edges remain straight, but the ends are curved and shrunk. The drier and better seasoned a piece of wood is the less it will shrink or warp; but it is never quite secure, and a great part of the skill of the worker in wood is shown in so disposing the separate pieces of wood that their warping or shrinking shall not damage the finished work. He will, of course, use the driest and best-seasoned wood he can obtain; but this precaution alone is not sufficient in all cases. For instance, your drawing-boards always have a piece of wood put across each end, with the grain running the other way to the rest of the board; the board is said to be clamped; or else it has pieces screwed across the back, in which case it is said to be ledged; in both cases the intention is the same—to prevent the board from warping.

Now I want you to take up again the laths we were using for flower-sticks, so as to make sure that we quite understand what we have been doing. Let us take four pieces and pin them together thus (Fig. 15), a form which you see exactly corresponds to the end elevation of our bookshelves with the bracket-pieces left out; and you remember that we found before that this structure would not keep its shape, and that, in order to make a serviceable book-case, we want all the four corners to remain securely

square, as we say in the workshop; in drawing or geometry we should say that we wanted all the angles to be right angles, which is merely another name for the same thing. You recollect that we can effect this by merely nailing a strip across, as shown by the dotted line, and then the corners will remain square if we have got them square to begin with. If you have learnt any geometry,—

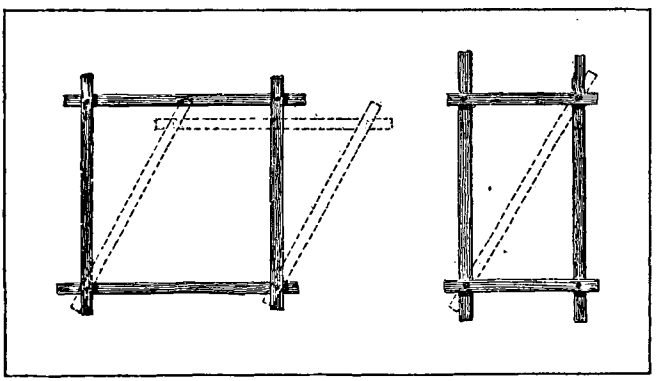

FIG. 15.

and if you have not you can discover it for yourself next time you are at the drawing-board,—you will know that if we have made the opposite sides exactly even in length, and if we then set one angle exactly square, all the other angles will necessarily also be square—that is, will be right angles. So that, in making any piece of work, we have first to measure our lengths very carefully, and then to make sure that we have fixed them at the proper angle. Though you will remember that if there are only three sides, that is to say,

if the thing is a triangle, measuring the lengths is enough. So, in making our bookshelves, we might have nailed a piece across to keep the ends square; but I am sure you will agree with me in thinking the little bracket-pieces look neater, are more shapely and pleasing to the eye. But the end elevation is not the only thing that has to be seen to; we must look to the front. Unless that also is square, it will be a very foolish-looking job. However, if we once get it fixed to the wall with a nail through each upright it will be all right, so we have only to make it strong enough to bear handling whilst we are putting it up, or perhaps some day to bear being taken down to move elsewhere. With this object the wall-pieces are made some 2 inches wide, so that there is room to get two screws through each into the shelves. Now this is just the way that the blade of a T square is kept in position; it is made wide enough to allow of several screws being put through it into the stock to hold it securely in position, and thus it is an instance of fixing an angle by strengthening the joint—the second of the two ways which we noticed when we first began to investigate such matters—that is, we may make the joints wide, and fasten them securely, or we may employ braces or brackets to make the structure rigid. Unhappily, we have not yet exhausted all the possibilities of failure in a bookshelf. In the library where I am writing there are some deal bookshelves 3 feet 3 inches long and about $\frac{5}{8}$ inch thick; they are just strong enough to carry a row of small octavo volumes, but have bent down

nearly an inch at the middle of a shelf of larger and heavier volumes, which looks very bad, and so our shelf, the wood of which is $\frac{1}{2}$ inch thick, will be sufficiently strong if it is only 18 inches long or so; but if we want a longer shelf we must use thicker wood.

To examine more closely into this let us take one of the strips we were using for the first exercise of all and square it up very carefully—$\frac{1}{4}$ inch on the side and 2 feet long. Then with handscrews arrange two supports overhanging the front of the bench, and a clear 20 inches apart, and resting our lath across them, we shall find that a weight of 1 lb. hung from the middle bends it down about $\frac{1}{8}$ inch; 2 lbs. will depress it $\frac{1}{4}$ inch, 3 lbs. $\frac{3}{8}$ inch, and so on. Next let us move the supports nearer together, say to 15 inches apart, then we find that 1 lb. only depresses the lath $\frac{1}{16}$ inch; it takes 2 lbs. to depress it $\frac{1}{8}$ inch. So we see that if the supports are nearer together the stick will carry more weight. Now let us take a lath that measures $\frac{1}{4} \times \frac{1}{2}$ inch, and with the supports 20 inches apart lay it across them flatways; then it will take 2 lbs. to bend it $\frac{1}{8}$ inch; being twice as broad, it is twice as strong as the first lath. But if we set it up edgeways, putting a wire nail at each side at either end to keep it from falling over, we find that the weight of 2 lbs. bends it so little that we cannot well measure it, and that it takes a much heavier weight to bend it as much as $\frac{1}{8}$ inch. Now this is a very important piece of elementary engineering, and well worthy of your attention; yet I believe that when you come to

think about it you will realise that you were not wholly ignorant of it; for you know that if you hold a sheet of notepaper by one corner, as long as you keep an edge uppermost it will stand straight out, but if you turn it flatways it doubles down at once. At all events, we have learnt that if we want to make our shelves stronger, a small addition to the thickness makes a great addition to the strength.

There are many variations you may make for yourselves on these experiments. You may fix one end of a lath to a support, and hang weights to the projecting end, and note the results of varying the weights, of putting the lath flat or edgeways, and of increasing or diminishing the length that overhangs. You may try what weight it takes actually to break the lath, all that is needed for this being a small bucket, and a supply of sand or shot; but you must take care to put a box or something underneath to catch the contents should the bucket upset when the stick breaks. All along compare your results with the rules given in books on mechanics and the strength of materials, and make sure that you understand them. Then you may reflect that the principles which we have discovered by carefully thinking out the how and the why of a little bookshelf apply to the construction of large buildings and the greatest works of the engineer.

Before leaving the question of brackets, there are one or two other useful forms that may be suggested. Here (Fig. 16) is a form of towel-rail which is sometimes convenient. You will notice

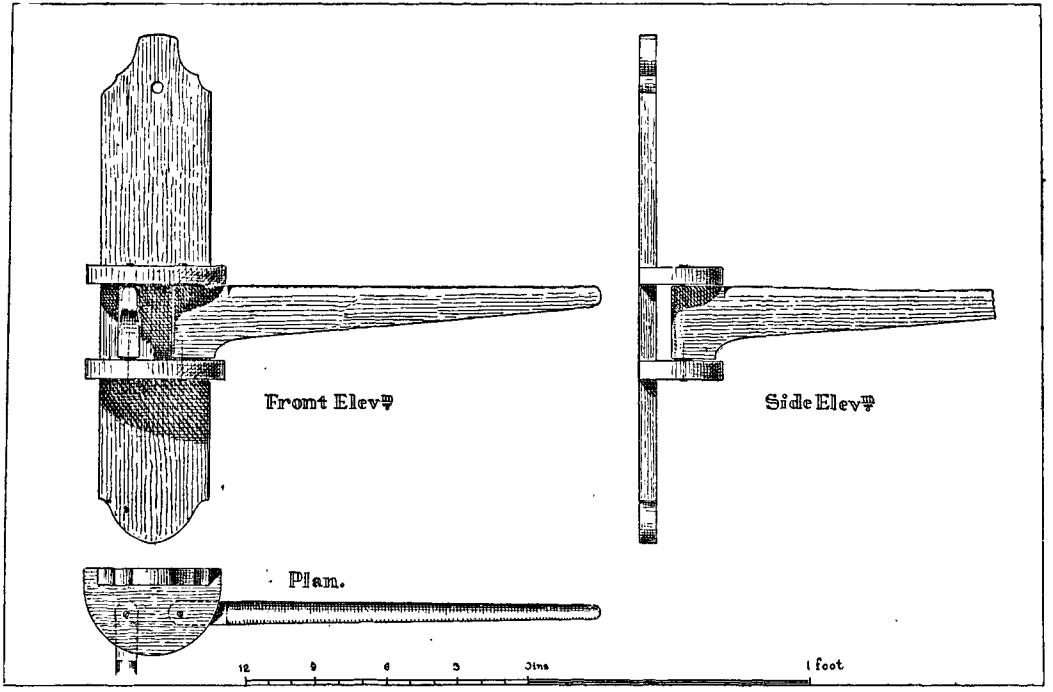

FIG. 16.

as before the long upright wall-piece to which are secured two small projections, between which the

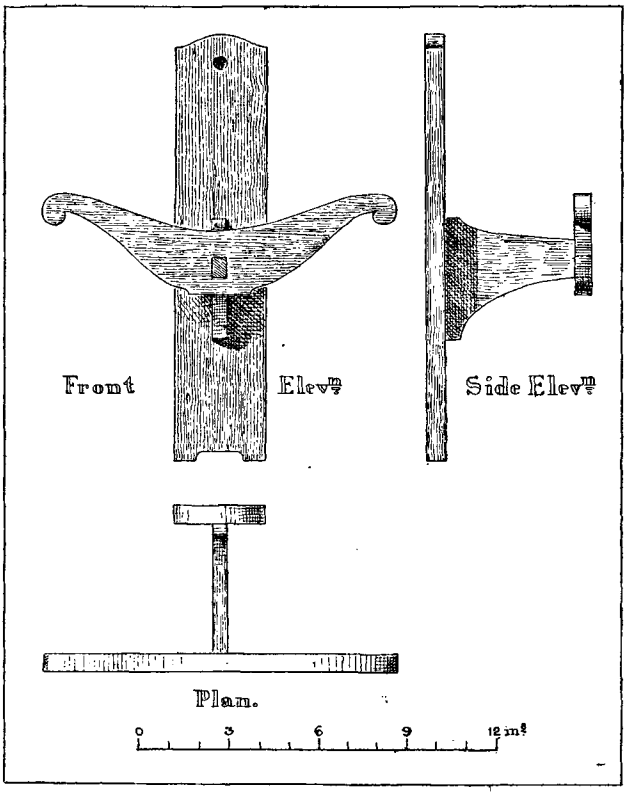

FIG. 17.

rails are pivoted. Long wire nails passed through holes in the rails will serve well enough for pivots, but you will want some sort of washer to prevent

the lower edge of the rail from grinding on its support, though a disc cut out of stout cardboard will answer the purpose. The hat-stand in Fig. 17 is a form of bracket. There is one of the sort in South Kensington Museum, very handsomely carved, of walnut wood some hundreds of years old. Common clothes' pegs too are really brackets; and, indeed, if you look for them, you will find them in all manner of constructions, —brackets of stone, wood, or iron under balconies; brackets of all sorts in

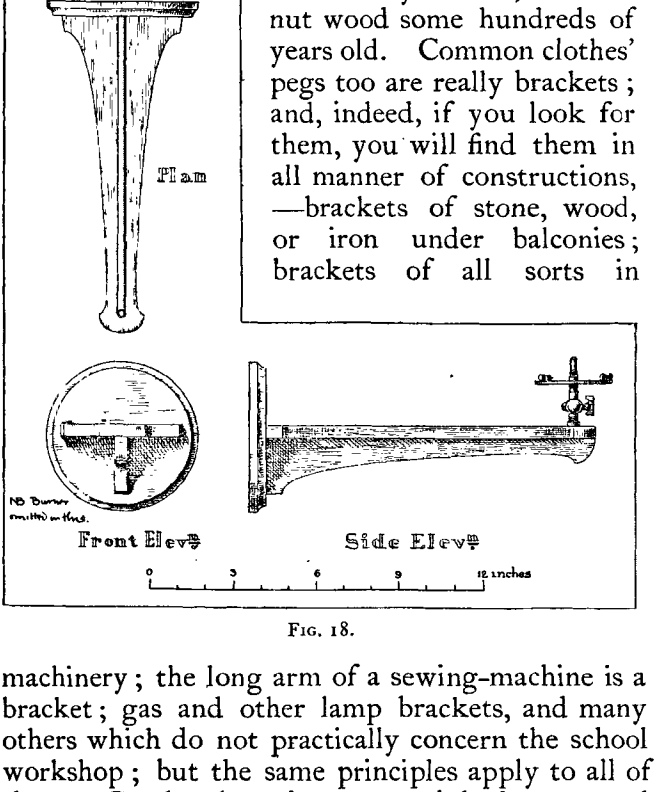

FIG. 18.

machinery; the long arm of a sewing-machine is a bracket; gas and other lamp brackets, and many others which do not practically concern the school workshop; but the same principles apply to all of them. Gas brackets, however, might be managed with a little help from a fitter, though gas is too

dangerous for amateur experiments; Fig. 18 is a suggestion for a wooden bracket supporting and carrying the pipe, which would be stronger and much handsomer than anything which could be bought at the price.

But it is time to return to the subject of boxes, and to try our hand at making something tidier

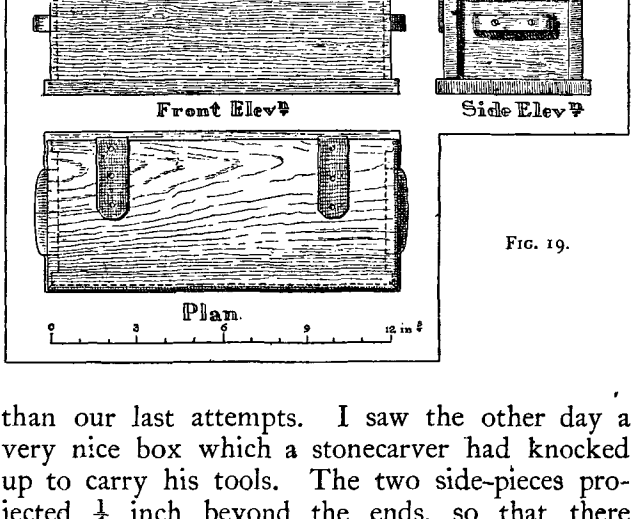

FIG. 19.

than our last attempts. I saw the other day a very nice box which a stonecarver had knocked up to carry his tools. The two side-pieces projected $\frac{1}{4}$ inch beyond the ends, so that there was less risk of the nails splitting the wood, and besides, the appearance is rather good. The bottom piece also projected so as to make a sort of bead all round, and at each end two small pieces were set as handles to lift it by. The hinges to the lid were merely two pieces of leather strap,

and the fastening was a third piece having a slit in it, which went over a staple in the front, and a peg passed through, which made all secure. Nicely painted or stained, such a box would be no eye-sore even in tidier places than a builder's scaffold.

Then there are one or two useful sorts of boxes with partitions which project, and are pierced to form a handle. Thus Fig. 20 is the box which farriers use to carry their nails, etc., and Fig. 21 is a knife-box; this is usually made with the sides

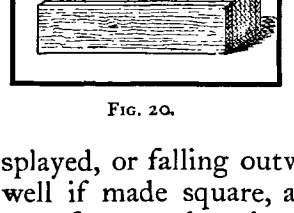

FIG. 20.

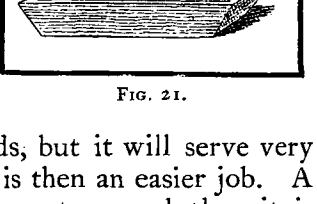

FIG. 21.

splayed, or falling outwards, but it will serve very well if made square, and is then an easier job. A very flat open box becomes a tray, and then it is convenient to have a handle at each end. This is usually, as in the previous cases, a hole cut to admit the fingers; but it may sometimes be better to make it as a projection rather like those on the stonecarver's box. Such is Fig. 22.

When skill is acquired to make splayed boxes, there are several forms of wooden flower-pots which, neatly made and painted, look exceedingly well in their simplicity; for instance, Figs. 23 and 24. Later on we shall have to consider various means of adorning boxes as well as other things, and in good time we shall have to recognise how large a

part of cabinet-making consists in making what are essentially boxes of one shape or another. For the moment we will only notice one more use of

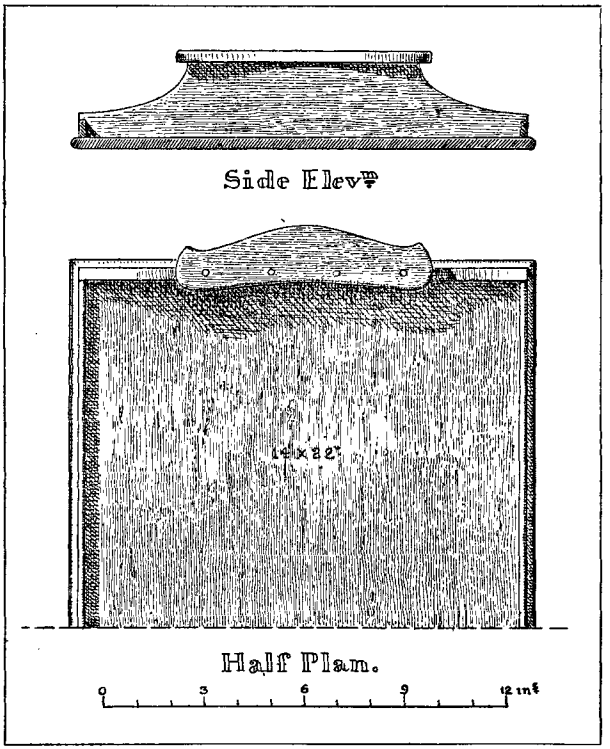

FIG. 22.

boxes,—quite plain boxes, but very accurately made they must be, and that is as measures of capacity. You have learnt that 2 gallons make

1 peck, and so on, which is useful knowledge certainly, but which will be still more useful if you know practically what these names mean, and so we will finish for the moment with the information that a box which measures inside $7\frac{1}{2}'' \times 7'' \times 10\frac{9}{16}''$ contains 1 peck, and one measuring $13'' \times 13'' \times 13\frac{1}{8}''$ contains a bushel—that is, if you have made them accurately and perfectly square at the corners.

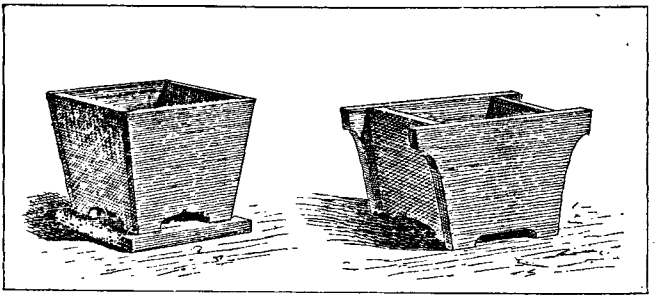

FIG. 23.

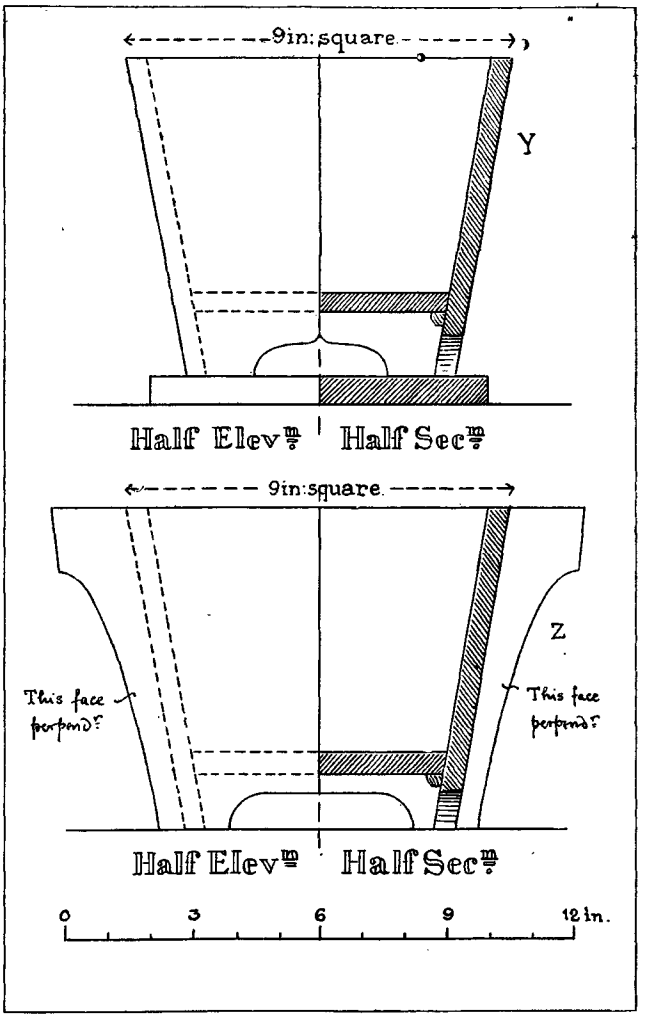
9in: square.
Y
Half Elev^m
Half Sec^m
9in: square.
Z
This face perpend^r
This face perpend^r
Half Elev^m
Half Sec^m
0
3
6
9
12 in.

FIG. 24.

CHAPTER IV

METAL WORK

THE hinges and fastenings of the box discussed in the last chapter were simple leather straps; and these, or for small rough boxes, strips of linen or

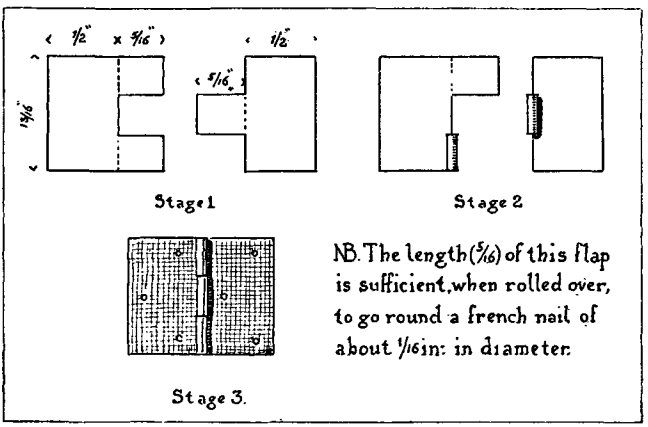
1/2" x 5/16"
1/2"
5/16"
1 1/16"
Stage 1
Stage 2
NB. The length (5/16) of this flap is sufficient, when rolled over, to go round a french nail of about 1/16 in: in diameter.
Stage 3.

FIG. 25.

cotton cloth glued on, will often serve well enough. As a rule, however, hinges are made of metal, and bought ready-made at the ironmongers, but the

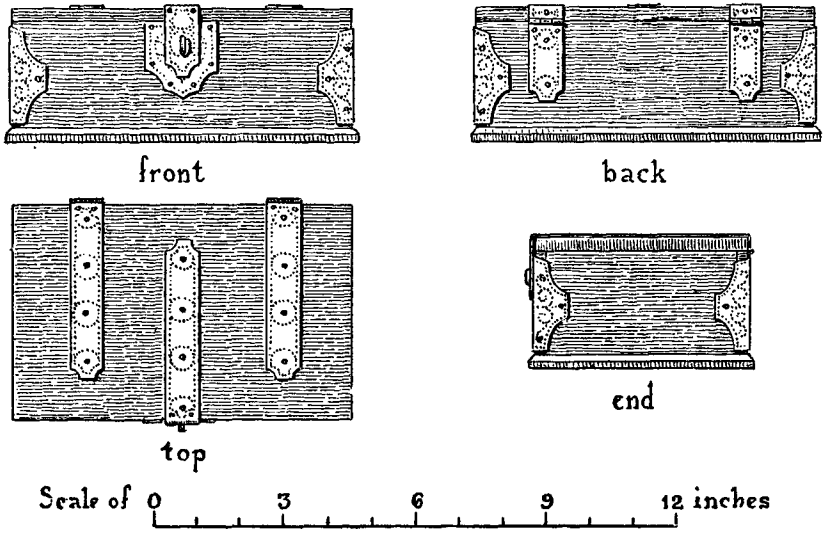

Fig. 26.

addition of a few tools to our stock will enable us to make very serviceable and even ornamental ones for ourselves out of what is very commonly waste material, that is, out of old tin boxes. We shall require one or two finely-cut files, a pair of tin snips, a small cold chisel, an iron vise, some bell-hangers' pliers; and, for more ornamental work, we may have some punches and fine fret saws, a light hammer, and some boxwood mallets. If you cut out two pieces of tin as above, and carefully curl up the projecting ends over a french nail or other stout piece of wire, holding the body of the piece in the vise, while you coax the projections round the pin with the pliers, aided by taps from a light hammer, you will not, I think, find much difficulty in making a hinge of some sort. Once this is fairly accomplished we may attempt a higher flight, and endeavour to turn one of our plain boxes into a handsome workbox or paper-case by the addition of long strap hinges, a hasp and corner plates to conceal the nails, or, it may be, the dovetails, which can be fastened on with gimp-pins or brass escutcheon pins; but there should certainly be small roundhead screws to secure the hinges close to the point where the greatest strain occurs. The holes for them may be drilled, or if no form of drill is available they can be punched; a broken bradawl filed off square at the point will do excellently, and though it leaves rather a ragged hole, that can be set right with a file applied to the back. Such plain forms as these can be cut with the shears and the edges finished with a file; but with more complicated shapes such as follow,

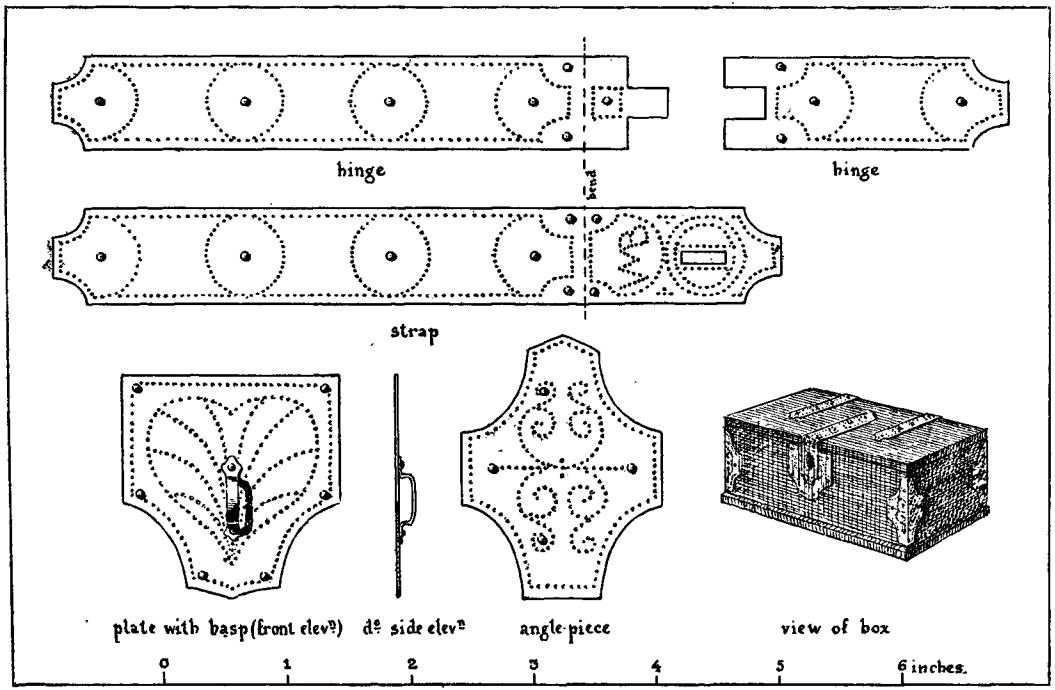
hinge
hinge
strap
plate with basp (front elevn)
do side elevn
angle-piece
view of box
0
1
2
3
4
5
6 inches.

FIG. 27.

you will probably find it easier to saw them out with a fine fret saw. The plainer ones look very well simply polished, but there is no harm in adding a simple punched pattern of dots and lines to them, while the foliated designs certainly look all the better for a little such work.

The reflector in the last chapter would be made in the same way, the edge being perhaps marked by a border of dots and lines. Of course it might be made very pretty by chasing or embossing, but I cannot say that I think that what is commonly known to amateurs as "brass work" deserves any very prominent place as an exercise for general hand training. A very few punches and tracers should, however, be at hand; for the decisive tracing of simple lines can be accomplished without too great a share of time being spent upon it. Before cutting the metal for any work of this sort, it were best to cut paper or cardboard patterns of each part, to make sure that you have measured and drawn them correctly, testing them by pinning them in place upon the wood. Anything that you can make of cardboard can, by simple means, be reproduced in metal; but, on the other hand, there are many forms which can be made out of sheet metal which could not be made of card or paper. Suppose that we wish to fit up the bracket, Fig. 10 in the last chapter, as a candle sconce; we should require to provide it with a socket to hold the lower end of the candle, and something in the way of a pan or saucer to catch the drip and make the whole thing quite secure against taking fire. The socket we can make by

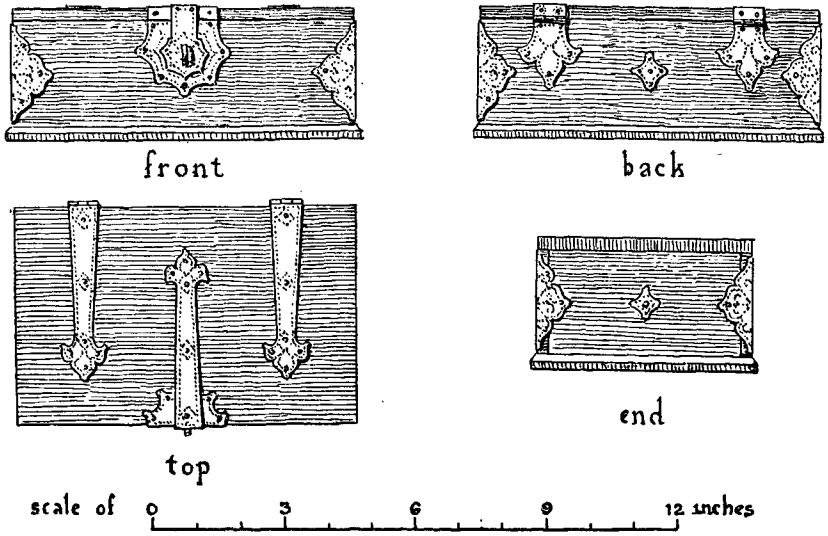

Fig. 28.

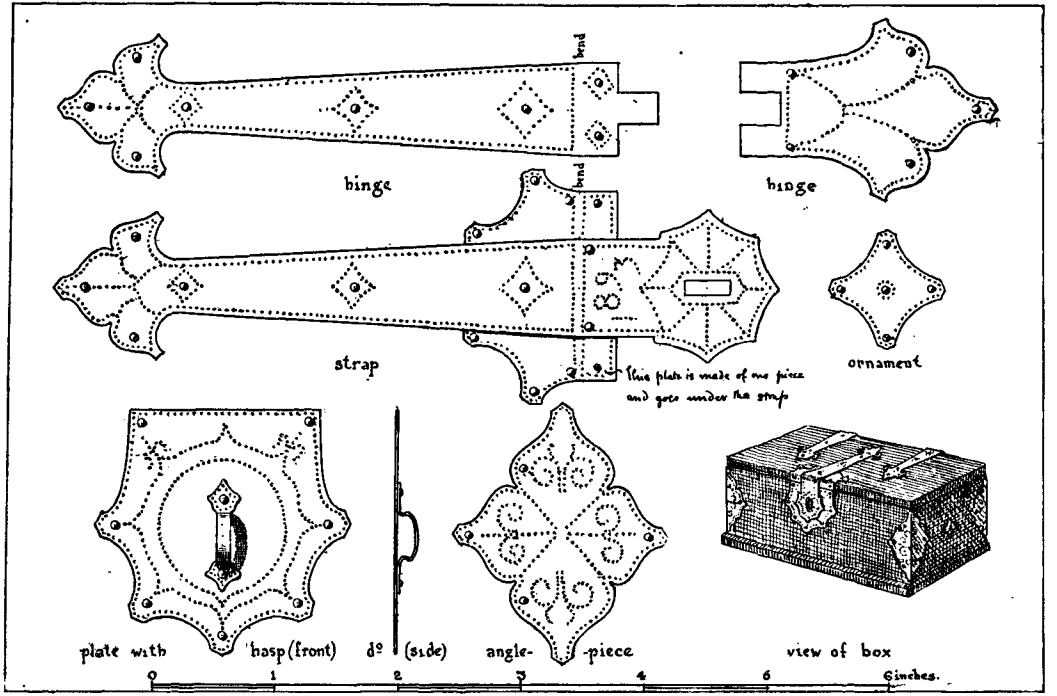
hinge
hinge
strap
ornament
This plate is made of one piece and goes under the strap
plate with
hasp (front)
dº (side)
angle-piece
view of box
0
1
2
3
4
6
6 inches.

FIG. 29.

bending up a piece of tin into a short tube, first scalloping the lower edge so that the turned-back scallops will give it a firm base and the means of attaching it to the pan by three or four rivets, or if you like by small screws through the scallops and the pan into the wood below. For the pan you must cut out a circular piece, say 4 inches across, and then with a strong pair of round-nosed pliers you could crimp the edge all round as in Fig. 32 to form a shallow saucer. Thus much you could

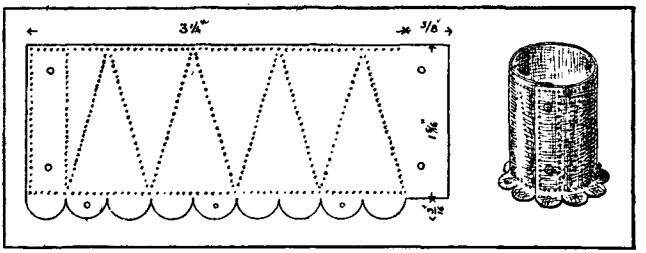

FIG. 30.

perhaps accomplish with tough paper or thin millboard; but with a round-faced boxwood mallet such as plumbers use, and a heavy block of wood, —a stump of elm-tree is commonly used,—with a few rough hollows gouged in the upper part, it is possible to mallet the flat disc into a rounding saucer which you cannot do with paper. If you think the question out you will find that you can only bend the paper in one direction at a time without crumpling or tearing it. You can roll it smoothly round a cylinder, such as a ruler, but you cannot wrap it round a ball without creasing it in every direction; for the paper is not plastic, it

will not be stretched, and it will not be squeezed in; the metal can, if you use force enough, both be stretched and be gathered in, as you may see if you get the chance of watching a plumber at work, making, for instance, the corner of a gutter. With the aid of variously-shaped mallets, he draws the metal out and gathers it together as he wants it,

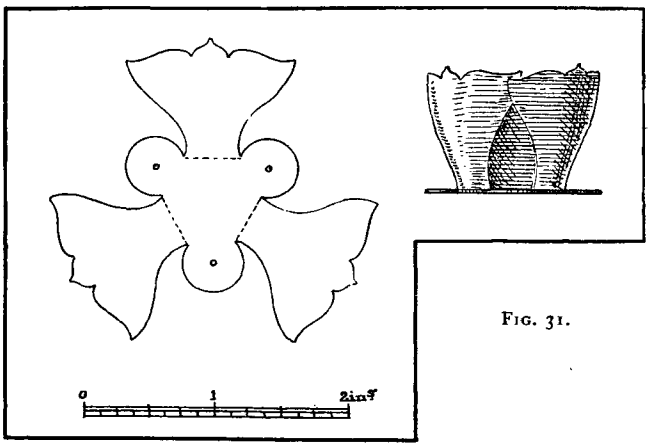

FIG. 31.

very much as you might work dough or plastic clay, and this is what is meant when metal is said to be malleable; you can mallet or hammer it into shape. But to do more in this sort than make a flattish saucer, or the like, is a task beyond an elementary lesson, and even so had better be first tried in a softer metal than tinned iron. Instead of making a tube for the socket or nozzle of the candlestick we might have cut out a piece of this form, and bent up the three leaves so as to embrace

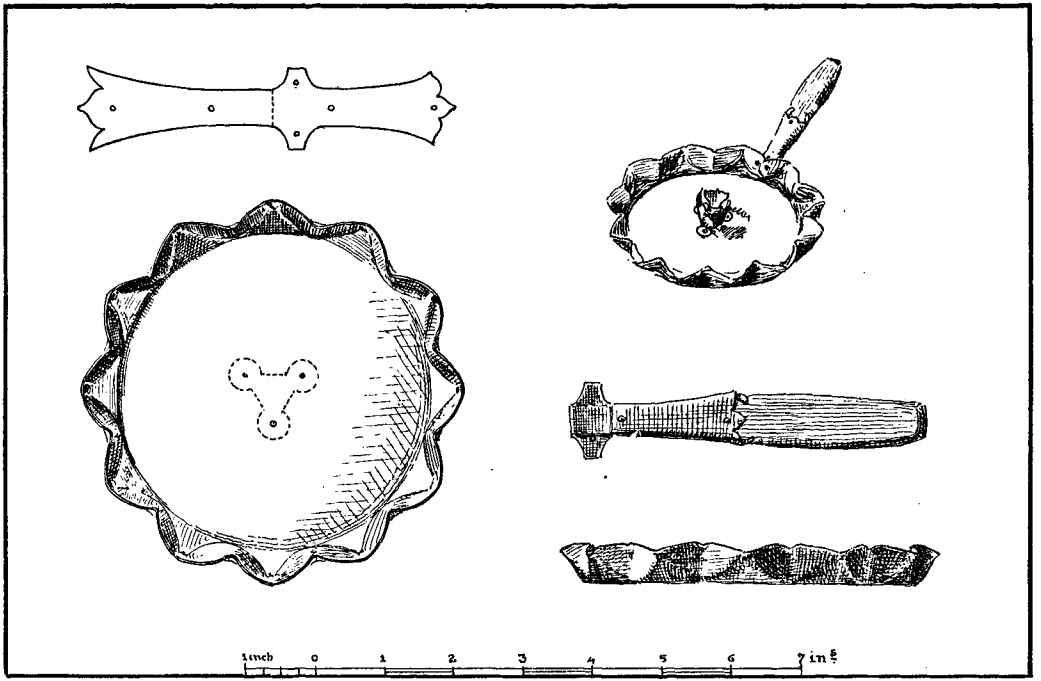

FIG. 32.

the bottom of the candle, and if you make the pan rather larger and fit it with a handle you will have a conveniently portable candlestick. The handle you had better make of wood which you can round off so as to be comfortable to the hand, and attach it to the pan by a piece of metal shaped as in the cut, rivets being put through the holes at the middle, and the two ends being bent up to form a socket for the handle, which must be pinned into it at two places. Brass escutcheon pins make the neatest rivets; you pass one through holes in the two pieces which are to be riveted together, and with a pair of cutting pliers cut the point end off just above the surface, and then, resting the head upon any convenient piece of iron, hammer down the projecting stump till the two pieces are firmly united.

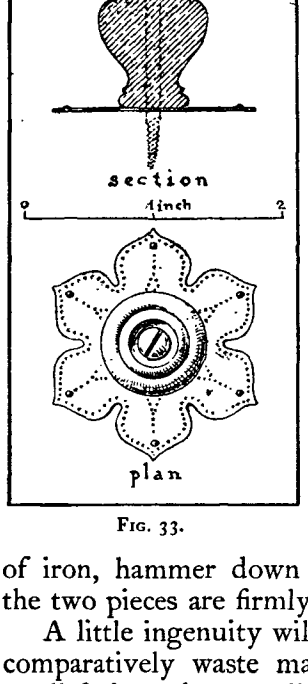

FIG. 33.

A little ingenuity will enable us to make out of comparatively waste material a number of other small fittings that usually have to be bought at the ironmonger's, or at all events substitutes for them that will serve to save a slender purse. Handles for cupboard-doors, or for drawers, and some

simple forms of catch or bolt can be made quite serviceable and sightly enough. Thus a star-shaped piece of tin with a little border of dots, or perhaps a single dot punched into each point, or with each ray veined, will make the mount for a small turned wooden knob drilled through the middle for a long round-headed screw, thus making

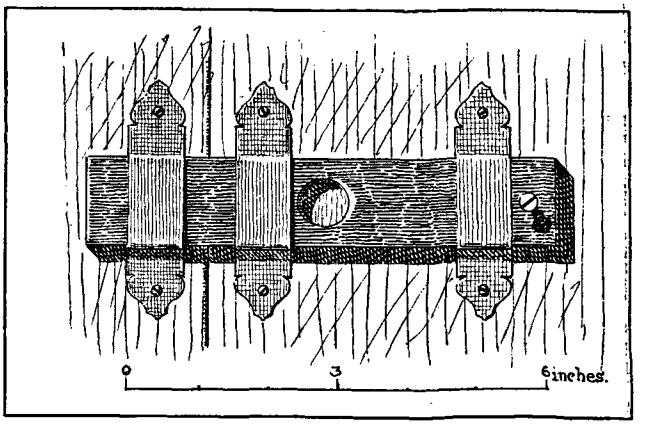

FIG. 34.

a little handle or drawer knob (Fig. 33) prettier than too many more pretentious things which one sees. Again, if there is a door which wants to be kept closed without needing a lock, will not this arrangement (Fig. 34) be all that is needed; where a slip of hard wood serves as bolt and slides in 3 sheet-metal clips, a mere finger hole giving the means of shooting or withdrawing the bolt? Fig. 35 again shows a suggestion for somewhat larger handles, with the actual

handle of turned wood held between sheet-metal angle pieces by a pair of brass-headed nails

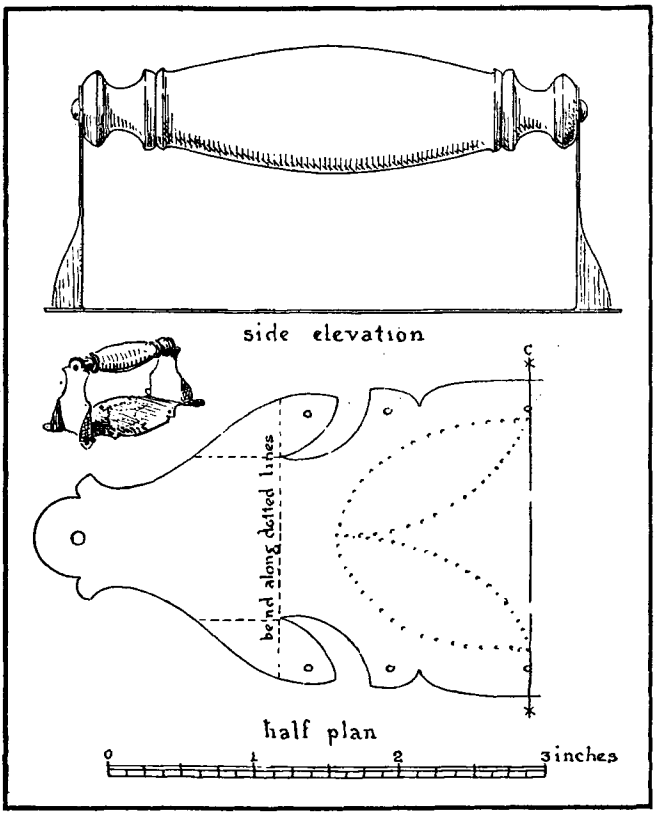

FIG. 35.

driven from the two ends. Though it is not often advisable to attempt to ornament such things to

any extent, a simple outline, either dotted or continuous, is often an improvement ; for this purpose it is convenient to clamp the metal down on to a piece of hard wood or plate of lead, screws passed through the necessary holes being often the readiest means.

In boys' homes a number of simple utensils of tin are made requiring the use of solder ; indeed the hinges we have been describing would be improved by being soldered when the socket for the pin is rolled over.

Soldering is a standing lesson in the nature of a clean surface, and whenever a teacher gets the chance of picking up the knack himself, it may well form an occasional exercise.

Any one with a turn for the work could easily learn to solder simple articles, if only he has the opportunity of supplementing the directions given in various books, by observing a tinsmith at work.

There is, however, another end to which the alloy used as solder can be applied in schools where the practice of handicraft is pushed beyond the simpler rudiments, and that is to illustrate the methods of casting, and the subsequent treatment of cast metal work by filing, turning, and the like. A full description of the processes employed would be out of place here, as it is unlikely that they could be practised except under specially trained directors ; but it is well to remember that most of the processes of the silversmith or the brass worker can be practised by working in an alloy of lead and tin which melts easily in an iron

ladle over a common fire; which can be cast in a sand mould and subsequently finished in any way that is desired; which may be adorned by chasing or embossing, and is in the end by no means an undesirable material for homely purposes.

CHAPTER V

FRET SAWING AND CARVING

THAT the fret saw is so generally known as an amateur's tool would in itself suggest that it is well adapted to the skill of a beginner. It is not a tool that usually finds a place in the tool chest of a cabinet-maker or joiner, trade fret sawing being nowadays mostly done in machines driven by steam power. However, what is commonly called fretwork cannot be regarded as a very admirable product of human industry, and it is rather as a convenient means of shaping curved pieces of small dimensions, and as a tool more easily handled by the beginner than the bow saw or compass saw of the artisan, that I commend it to the notice of teacher or amateur, and have already suggested that certain pieces of work should be accomplished by its aid. In metal, however, fretwork, in this case denominated *saw-piercing*, is constantly employed with excellent effect—as may be seen by examining the many examples of its use in past time preserved in our great museums. But even in wood we shall not unfrequently find that the power of piercing out some portion of our work is a

desirable one; most obviously in such cases as small frames for photographs and the like, cut out of a single piece of wood the outlines of which may also be executed with the same tool (Fig. 36). In short, a fret saw is a convenient and useful tool in combination with others, but to rely upon it exclusively for the production of ornament and construction of any elaboration is futile in the extreme.

Carving is a much more serious matter, and in its higher branches it demands long training added to great natural capacity. Nevertheless, in its simpler forms, carving is a valuable means of training, and may, furthermore, become a most happy recreative accomplishment to many who could scarcely hope to succeed in making their mark if they took to it professionally and devoted a life to it. The special merit of the handling of a carving tool, viewed educationally as a piece of hand-training, lies in the absence of guidance in the tool itself. It is sharpened on both bevels, and whatever purpose there is to be in the cut must be put into it by the operator. Its value has, however, already been abundantly recognised by the pioneers of such training, so much so, that one has to counsel some restraint of the whittling instinct; and to enforce the necessity of teaching also the proper application of ornament, and its reasonable distribution in relation to structural forms, and to the available time of the worker. We have already had what I may call a nibble at the carver's craft over our flower sticks, and perhaps the next step should be the Scandinavian chip carving, of which

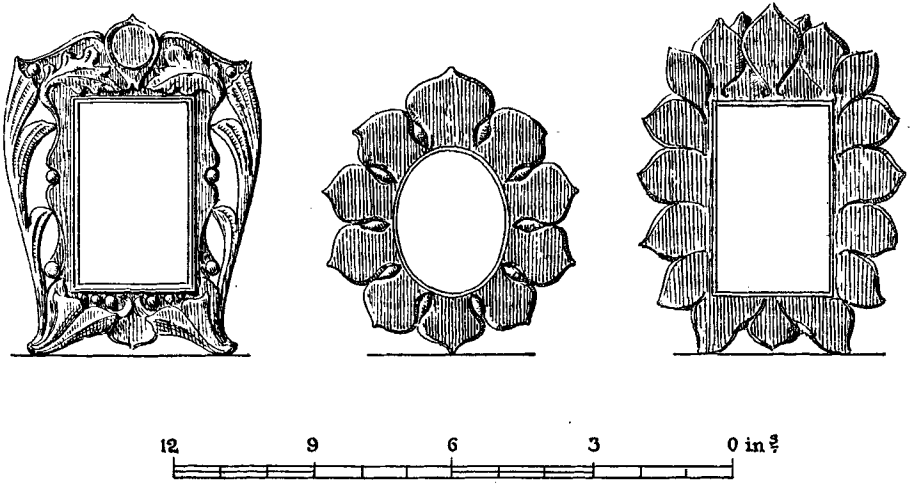

Fig. 36.

I need say little, as there is an excellent introduction to its practice by Miss Rowe; but again let me say the word, restraint; one can have too much chip carving, and it is chiefly pleasant in smallish articles and in contrast to considerable surfaces of plain wood. But another and much more interesting kind of carving hails from the same lands, consisting of finely flowing and interlaced patterns on a slightly sunk ground, which is usually left rather wavy or facetted, as if cut with a knife or common chisel, rather than with special grounding tools. Some people take great pleasure in the designing of such intricacies and knots, and there can be no doubt of their beauty when well executed. But I feel that in England at all events, the kind of work that was extensively popular among our forefathers in the rural districts, and which has a traceable derivation from natural forms, has many advantages for school use. For instance there can be no question that oak leaves and acorns have been in

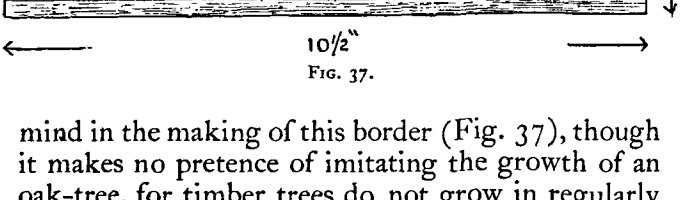

FIG. 37.

mind in the making of this border (Fig. 37), though it makes no pretence of imitating the growth of an oak-tree, for timber trees do not grow in regularly recurring curves with single leaves alternately on

either side ; yet there is a pleasant suggestion of the general shape of the leaf and the acorn, which is quite distinctive in spite of the formality of the design. For the beginner, it is best firmly to outline such a design, and then to sink the ground about $\frac{1}{8}$ inch to $\frac{3}{16}$ inch. Much charming old English carving is executed thus with no attempt at rendering natural modelling, the plain surface of the patterns being merely relieved by a few V-shaped veins cut into it. To be able to cut such things cleanly, and with that instant precision which gives the feeling of life, is a long step on the road to excellence; and it is perhaps the furthest point in the direction of carved surface decoration within our present scope. But there is another use of carving tools which is mechanically of yet more value in the command it gives of form; I mean the application of carved work or fancy chamfering to the finishing of the ends and edges of things. Thus the bracket backs in Chapter III. can be greatly improved by a little ornamentation at top and bottom; it may be no more than a flowing chamfer relieved into a leaf-like form by an incised line within ; from this it is but an easy step to the upper part of Fig. 38,

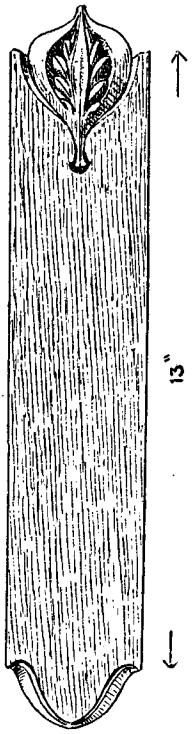

Fig. 38.

suggestive of the growth from earth of such plants as hyacinths with their clustering buds within a sheath of leaves; and thence one step more gives us the group of wild tulips and their sword-like leafage which ornament the upper part of the bracket in the succeeding sketch (Fig. 39). But this is rather more than an elementary example of a practice which is still common in certain trades. Notably it is in use among the builders of carts and barrows, to which flowing chamfers, lined out with colour, form a familiar but most effective decoration; a scheme which is carried still farther by the builders of certain gipsy vans, which are enriched with bold carvings often picked out with daringly brilliant colour. Now in these instances there is a point I particularly wish you to regard, and that is that this decoration is by common custom an accepted part of the work, and so to embellish it is in the ordinary course of the builder's business; and thus far, in however humble a degree, it is typical of all the finest ornamentation, in that it is the fit completion of the man's work. And though in life's economy it may be well that a special gift for ornate work should receive specialised employment, such that the world gets the greater enjoyment from it, yet at school it is otherwise, and decoration must not be thought of as a special and distinct province of industry, but as the legitimate completion of a necessary work brought to its full perfection, as the outward and visible sign of good and honest craftsmanship, without which indeed that craftsmanship would be in a manner rude and defective.

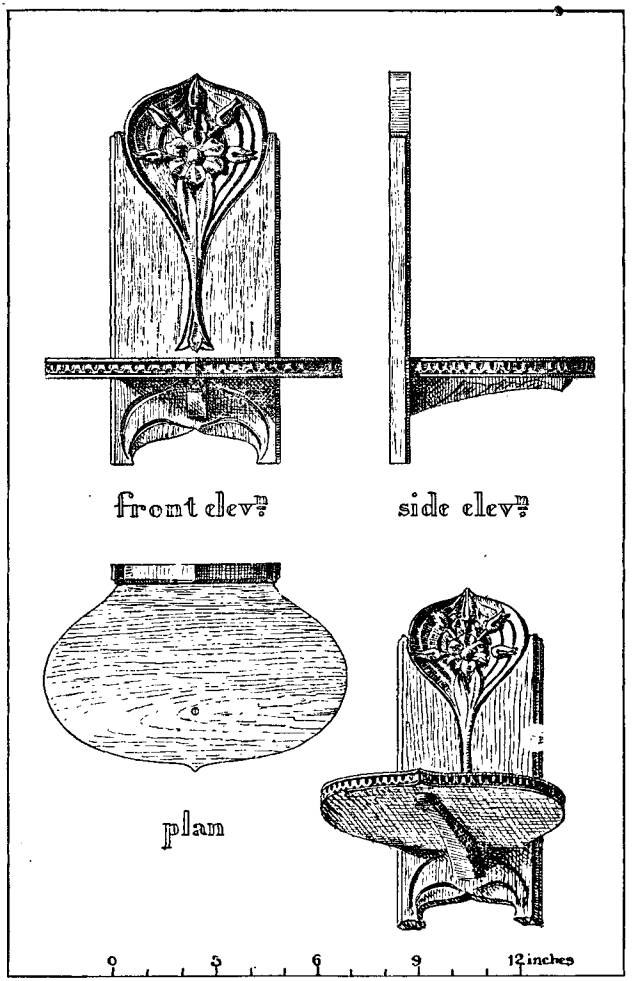

Fig. 39.

Now to the acquiring of these pretty manners there is but one royal road, and that is to mix in good company, the company of the fine work of our forefathers, and of those among us who are developing the old traditions in harmony with the necessities of a newer day. And so, just as the child is taught to salute, and to bow or curtsey, to shake hands and to say, Good-morning, so should the rising craftsman be taught the good manners and even the airs and graces of a fine style. Above all, beware of the suggestion that beauty is a thing apart, to be added to specially favoured wares, rather than an essential in all right workmanship, from the furrow driven by the ploughman, to the glorious cathedral towering over its ancient city.

As to the actual handling of carving tools much has been written that may be read with profit, if only as an aid to observation and to the memory of what is observed, when opportunity arrives of examining fine work, or watching a skilful workman. Where these books usually fail, is in mixing up, so to speak, the manners and languages of many different times and countries. For, be it understood that while all good manners are founded on courtesy and kindliness; they take different forms under different circumstances; a Japanese fine gentleman has a different style from a Frenchman or an Italian, and all these, however right and perfect in their way, are not English manners; though we ought to be ready to take any hints they may offer in practical kindliness, yet if we try to combine the lot we shall make a queer mess of it, and persuade no one that we are anything but

affected prigs. And it is very much the same with our present concern, style of workmanship; and such books are very apt, after telling us much that is instructive so far as it goes, to end without telling us anything about modern style, and to leave us in ignorance that there is a fine modern English style, though in our busy concern for the markets of the world we rather too often forget it. But here we are not much concerned with this, but rather with the foundations of all styles; that is, in mechanical necessities and the beauty of the natural world about us. Yet the teacher should remember that, while he is talking of these things, he is preparing the way for their crystallisation into what is called a style, just as common human kindliness crystallises into a recognised code of good manners.

CHAPTER VI

THE POLE LATHE

On the borderland between tools and machines stands the turning lathe, an instrument so fascinating in its manipulation that it is the ambition of every mechanically-minded boy to have access to this, the favourite hobby of many an amateur, to whom indeed it often proves rather a costly toy. And yet much of the instruction that is to be got out of a lathe may be acquired at a very small cost, and by the aid of a few trifling additions to the ordinary carpenter's bench. Not so long ago every farm carpenter knew how to improvise the primitive form of the tool, the pole lathe; and with the possible substitution of a rubber or spiral steel spring for the somewhat unwieldy pole, I strongly urge its introduction wherever lads are taught to handle tools. The apparatus, which is still in ordinary use in many trades, as well as universally in out-of-the-way regions, essentially consists of a pair of centre points, between which the work to be turned is rotated by a cord passed once round it, and the means of supporting the centres. In Fig. 40, a piece of wood held in the vise of an ordinary carpenter's bench carries

the left-hand centre; the other consists of a thumbscrew passing through one arm of a wooden T, the stalk of which lies on the bench top, ready to be clamped to it at any point of the length of the bench; a third piece, similarly clamped, carries

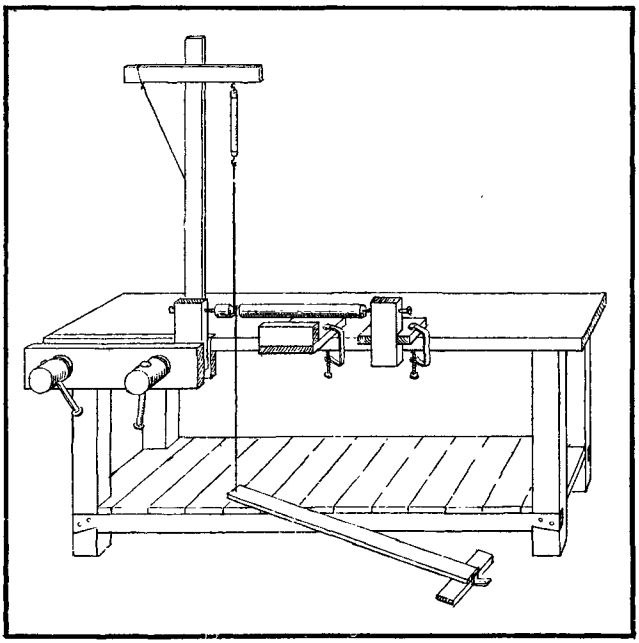

FIG. 40.

the tool rest. To the back of the left-hand "poppit" (as the pieces which carry the centres are termed) an upright is screwed, carrying at the top a cross arm from which hangs a rubber spring, in fact a common door spring. The piece of wood to be

turned is first roughly rounded by hand and then centred between the two points; round it the cord depending from the spring is passed, and the lower end fastened to a long treadle, the other end of which may conveniently be secured to the ground by a leather hinge. Pressing on the treadle draws down the cord, thus rotating the work so that a sharp tool held up against any part of it reduces that part to a circular section; when the pressure is relieved the spring draws back the cord, raising the treadle for another stroke and another cut. To minimise fatigue both hands and feet should be used in turn. Except that the cut is intermittent and the speed less, there is little difference between the manipulation and that required in the modern fly-wheel lathe. I do not know if it is possible to acquire the art of turning from descriptions of the manipulation to be found in many books upon the subject. Certainly all the turners I know have learnt in great measure by watching others turning and being shown how to apply their tools to the work; but as in the case of most practical methods, reading helps to fix the teaching in the mind, and enables one to use every opportunity of a practical lesson or observation to the best advantage, by preparing one to look for the right things.

Now on the pole lathe anything in the nature of a spindle, the legs of furniture and the like, can obviously be turned, if with more labour, yet with no more need of contrivance than on other lathes; and the less speed is rather an advantage to the beginner as diminishing the risk of his grasp of the tool being overmastered by the swiftly revolving work. So,

for a first exercise, I suggest a holder to use up the ends of pencils which have been sharpened till too short for drawing with. For this purpose you take a piece of wood say 9 inches long and about 1 inch square; trim it roughly round, and then place it between the centres, and turn a shallow groove about $\frac{1}{2}$ inch from the right end; then take it out and replace it with the cord lying smoothly in the groove, and proceed to turn it to shape

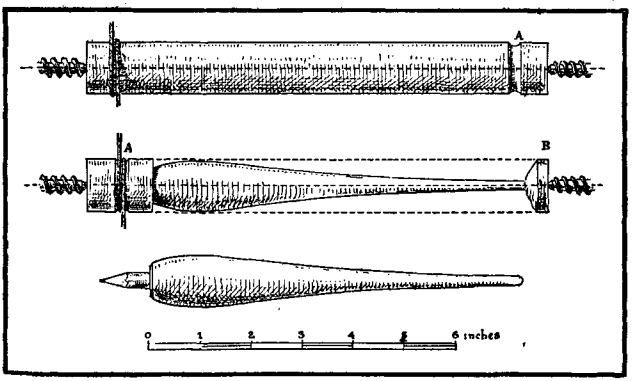

FIG. 41.

thus (Fig. 41). Then you must deepen the nick at *a* as much as you dare without risk of breaking, then cut right through the stick at *b*, and finally with a knife or chisel you must cut away the piece that served as a pulley, and bore the hole to take the pencil. Another good exercise is afforded by the making of hat-pegs, the chief difficulty being to get the pin a nice fit for its hole, which you have to bore with a centre bit and cannot well modify

the size of (Fig. 42). Tool-handles, again, are good practice, and most books on turning begin with full directions for making them.

Now, if you want to turn a disc, say the wheel of a small barrow, your first step must be to take a suitable flat piece of wood, and drill a hole through the middle of it with a centre bit (Fig. 43); you then take a piece to make the axle and turn it, making a short length in the middle of it an exact

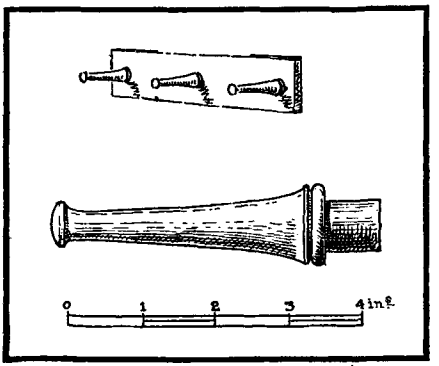

FIG. 42.

fit for the hole, and leaving a shoulder up to which, after gluing, you drive the flat piece and leave it to dry, when you can turn it in the ordinary way. Wherever any attempt is made to give instruction in physical science the power of making wheels and pulleys becomes valuable; and in this unpretentious manner a great deal of the apparatus figured in books on mechanics can be improvised with little difficulty—such as the windlass and a rough but quite instructive "Atkin's machine."

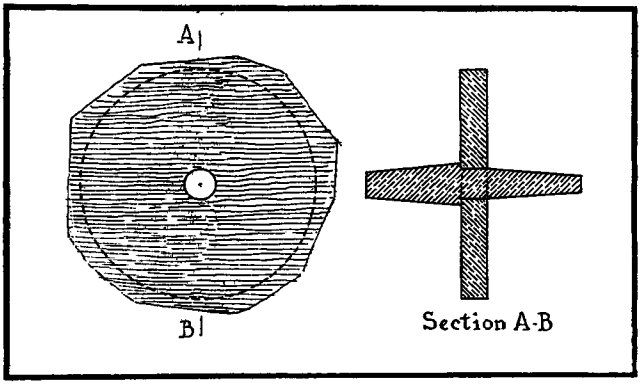

FIG. 43.

Then there is the spinning-top which, though a toy, has many claims to be admitted as a scientific

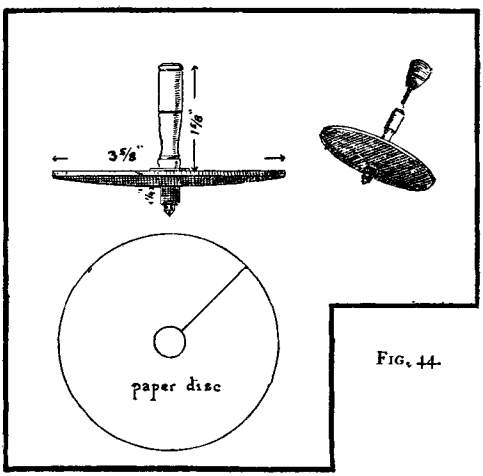

FIG. 44.

instrument, embodying the principles of the fly-wheel and the gyroscope; and one form of it known as Maxwell's colour top is indispensable to

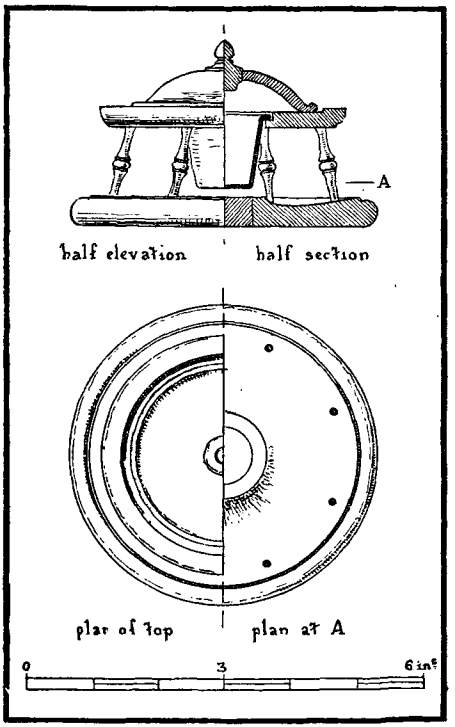

FIG. 45.

the teaching of the science of colour (Fig. 44). To make a top you proceed exactly as in making a wheel and axle, the only thing to remember being that the heavier the wood of which the disc is made, the

better it will spin. To spin it use a french nail with the point carefully filed smooth, fitted into a wooden handle, like a bradawl in fact, to fit which a hole is bored in the spindle of the top. A further improvement is to give it a bone or metal point which will greatly diminish the friction in spinning. This top is made into a colour top by means of discs of coloured paper, which fit over the spindle, and two or more being put on at a time, when the top

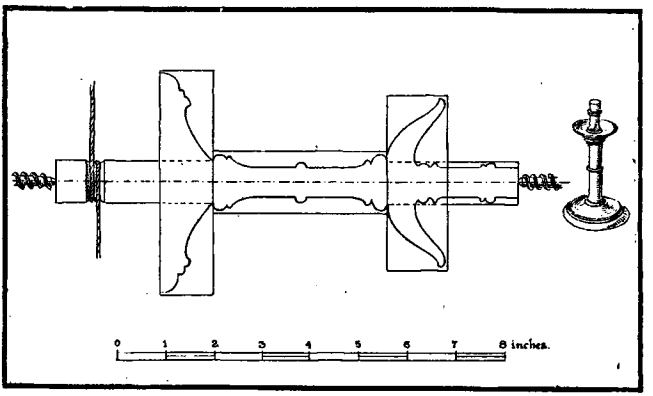

FIG. 45.

is spun the different colours are blended into a compound tint. A flat tray can be turned in the same manner and the hole for the spindle afterwards plugged ; and a ring is turned by cutting it from the edge of a disc thus mounted, taking care not to separate it wholly from the central portion till it is quite finished at every other point.

With a ring and a flat tray and a set of small turned spindles, one can make a substantial stand

for the ordinary porcelain ink-well (Fig. 45). Again, a candlestick can readily be turned out of two flat pieces for the base and saucer mounted upon a spindle which forms the stem; the socket for the candle should be made of metal, and may either be a short piece of tube or made out of sheet metal as described in Chapter IV.; the last operation in finishing the turning is, of course, to cut off the length of spindle to the left hand of the base (Fig. 46). The two last examples suggest the following arrangement by which a common glass tumbler or even an old tin can may be mounted as a quite presentable flower-vase (Fig. 47). Lastly, here is another ink-stand, but you will, I expect, have to bore out the well hole with a large centre bit (Fig. 48).

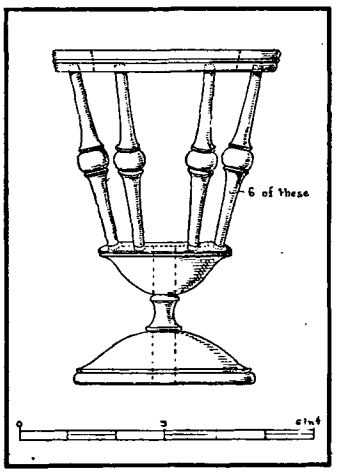

FIG. 47.

Hollow shapes, too thin to be strong enough in wood, can be produced in papier-maché, which is made upon a turned wooden form. The form is well soaked with linseed oil applied again and again, and then the paper is pasted on in layer after layer with strong book-binders' paste. When it is thick enough it is left to dry, and then baked in the oven at a gentle

heat; after which the rough ends are pared off with a sharp chisel or knife, when the paper comes freely off the mould, ready to be finished by colouring and varnish. By soaking in melted paraffin wax (quite a different thing from paraffin oil remember) such vessels may be made water-tight, and will even resist acids and other chemicals.

That it would be possible to carry the use of the pole lathe much farther, and to turn small

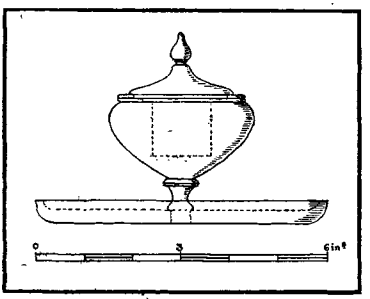

FIG. 48.

articles of pewter, or even brass, I can well believe, though it is not often likely to be advisable to make the attempt. And yet as a rudimentary technological exercise in a metal working district, it might be useful to turn patterns, cast them in pewter or solder, and turn them in the pole lathe. It would only be necessary to prepare each piece so that it could be, as it were, spitted upon a wooden spindle; but it is scarcely likely that fly-wheel lathes would long be beyond the reach of a school of this sort.

CHAPTER VII

COLOUR

BEFORE this chapter is reached we shall already have made acquaintance with the subject of colour, not only in the kindergarten, but also in the drawing school, in the shape of the water-colours used for tinting working drawings. In view of the widely-diffused importance of the colour sense it is strange how little care has been bestowed upon its cultivation; strongly implanted by nature in the child, it is allowed to wither for lack of training and opportunity, till in the grown man, when perchance its application suddenly becomes a pressing need, the sense itself appears to have almost perished. Large as is the number of employments, such as painter's work and dyer's, in which an eye for colour should be an obvious necessity, and passing over such crude instances as the distinguishing of the colours of marine and railway signal lamps, we shall find there are a yet greater number of processes in which accurate observation of delicate differences of tint is a main factor in success—such, for instance, as the tempering of steel and the management of the electrical

storage battery. And although this specialised perception cannot be taught at school, the way to its acquisition may well be smoothed by the early formation of the habit of taking note of colour. Moreover, when we turn from a commercial to a humanist standpoint, we find in the sense of colour an influence scarcely second to that of music, in effect upon the nerves and in the possibilities of pleasure which it embraces. It is not for nothing that children take such keen delight in bright colours; nor is the azure of the sky or the golden tint of harvest pleasant to us only by reasons of association; delight in them is an intimate part of human nature. And to that rightness of form which we know to be an element in all perfection of workmanship, we must add, as in like degree essential, pleasantness of colour and surface texture.

Now the colouring of an otherwise finished piece of work is in the outside world usually a trade by itself, and no part of the business of the man who gives it form. But we cannot admit this sort of specialisation within the school, or allow that the appropriate colouring of an object is beyond the ken of those who gave it shape; and, therefore, in spite of an abhorrence of mess, a plea must be entered for the place of paint in the school workshop,—a place which it will share with the preparation of glue and paste, and perhaps other processes which demand cleanliness the more by reason of the facilities which they give for the opposite, and which may be regarded as the point of contact between the workshop and the science of chemistry.

In our opening exercise we were brought face to face with the colour question, as we found that our flower sticks required a coat of oil paint, not merely for the sake of preserving them from the evil effects of damp, but also to improve their appearance; the colour of common deal, originally poor and unsatisfying, tending rather to get worse than better with age and dirt. Though small articles may be stained green or black, and polished or varnished with fair success, the soft wood is so readily bruised that the surface soon becomes impaired; while the attempt, so frequently made, to stain deal in imitation of richer woods, is highly unsatisfactory in its results. So that on the whole, even for indoor work, the commoner timber is best painted solidly with oil colours; while outdoors, for all but the roughest structures, paint is eminently desirable as a protection from the weather.

In an ordinary school it is probably not advisable to attempt to mix paints for use in quantity, as they can be bought mixed ready for use quite as cheaply, apart from the probability that they will dry more satisfactorily when prepared by a colourman. There is no lack of published directions for the manipulation of paint and brushes, those in *Every Man his own Mechanic* being as good as any I have seen; though in regard to decorative treatment, small value is, for the most part, to be attached to what such treatises have to say. Perhaps the first thing to learn about decorative colour is, that while all good colourists share the child's delight in brilliancy, they soon discover

that bright colour in the state of paint cannot be used recklessly, and spread over large surfaces, without defeating its own object, by fatiguing the eye. If you have a considerable surface to colour, you have to soften your hues by toning with gray or white, and thus you can get small touches of full strong hue to look really and pleasantly brilliant. In this we are but following nature, where we find that really bright and strong colours mostly occur in small patches—as the poppies in the corn. Even the level grass, which looks so bright in the sunlight, is not a smooth expanse of what we call grass green; for if we examine carefully we see that it is broken with many tints of yellow and brown and gray and glittering reflections of sparkling light, that entirely alter the hue of the meadow at large. A bewilderingly complicated subject it seems when one is first introduced to the study of colour, with all its variations of hue and of intensity, of tint and shade and tone, endlessly modified by the condition of the surface on which it is seen. And yet, for our purpose, the simple colouring of a few simple forms, the choice is really not very bewildering; there are not so very many colours really suitable. Indeed, for general out-door work with oil colour, we are all but limited to these: black, commonly in the shape of tar or pitch for the rougher jobs; white; and one or two tints of green. As I have said, it is most likely that for use it will be found advisable to buy such paints ready mixed; but it is necessary that we should be able to prepare standard patterns of the colours we require; and for this purpose tube

colours are convenient and economical. The ordinary fourpenny tube when squeezed squirts out a little cylinder of colour about $\frac{1}{8}$ inch in diameter, by measuring the length of which we can, with fair accuracy, determine the proportions in which to mix the pigments. Thus, squirting one inch of prussian blue on to a palette, and $\frac{3}{4}$ inch of chrome orange, we can mix them together into a fine deep green; we can increase the proportion of chrome to one inch, and obtain a more vivid green; but between these limits we shall find that almost all out-of-door requirements are satisfied, so far as green is concerned, and no better colour can be found for such things as garden seats, trellis work, and flower sticks, outside shutters, and similar wood-work about the house. Iron-work is generally best painted a glossy black; while wood-work in association with glass, such as the frames and sash bars of windows and conservatories, nearly always looks best white—not blue white, but rather inclining to cream. Creamy white and green, alternating in various proportions, are usually sufficient for almost all out-door wood-work, except such as is usually tarred black; but the practice of barge builders and the makers of gipsy vans may give us hints as to the possibility of picking them out with brighter colours. Thus the notched upper portions of our garden sticks may be painted white, and the edges then picked out with venetian red, or with deep chrome yellow.

Passing to in-door colour we must be yet more careful not to use an excess of strong colour, and at the same time, make every effort to keep

our tints clean and clear. Creamy white and green still remain of the greatest general use. But to the full shades of green, we may add one composed of 1 inch prussian blue, 1 inch flake white, and 1 inch orange chrome. For red, we can use pure venetian red and a pink, made of venetian red and flake white in equal parts. For blue a pale tint composed of 4 inches white, 1 inch prussian blue, and $\frac{1}{8}$ inch chrome orange is the most useful. Yellow is not much used in oil colour except as before mentioned for picking out in combination with white on a green ground, and then one must use the pure chrome, painted over white under-colour. These will give you enough tints for ordinary purposes, except that you might want burnt umber to stain a floor with ; which for variety may be turned slightly greenish by an admixture of prussian blue. Otherwise brown and black pigments, though much affected by indifferent colourists, are of very little use in decoration, and tend to produce a very undesirable series of muddy and foxy hues. When you have to paint work which is enriched with much carving, it will be well to use white, or, at all events, a light tint, otherwise the effect of the carving is apt to be lost in the darkness of the colour, unless the carving is picked out with other tints, or with bronze colours, such as the so-called gold and silver paints ; but it is quite possible to overdo such picking out, and for most purposes a quiet even tint is preferable.

So far we have been considering the use of pigments ground in oil, that is, of more or less

earthy materials reduced to a fine powder, and mixed with specially prepared oil or varnish into a pasty fluid, which, when spread thinly upon the work, dries into a sort of skin upon it. But for large surfaces of wall, instead of mixing the pigments with oil, they are commonly used in the form of distemper, that is, they are mixed with size, which is weak glue, the simplest form of distemper being the familiar white-wash. Whereas, in painting a door white, you use white lead or zinc ground in oil; for a plaster ceiling you use whiting, which is simply prepared chalk, mixed with size, which as it dries glues together the powdery particles, and sticks them to the plaster. The published directions for mixing white-wash usually contain the old fashioned and very unscientific addition of black, by way of counteracting the slight yellowness of the size; this is not on any account to be followed, as by so doing you only sully the fairness of the white and spoil its beauty. Various tints of colour-wash can be made by adding appropriate pigments to the white. For the purpose of preparing patterns, we must have some whiting soaked in water till it is a uniform paste, and for stainers we can use the twopenny tubes of moist water colour. Taking a teaspoonful of the whiting, we add 1 inch of prussian blue and $\frac{1}{8}$ inch chrome for a blue tint, $\frac{1}{2}$ inch prussian blue and $\frac{1}{2}$ chrome orange for a green wash, 2 inches venetian red for a pink wash, and 2 inches yellow ochre for a yellow wash, in each case with a teaspoonful of whiting. In mixing the colours the brush should be moistened with warm water to which a little

weak glue has been added. Though it is possible to produce deeper tints in distemper, they are difficult to manage, and these pale tints contrast nicely with the more glossy oil paints which are so serviceable upon wood-work, and on those parts of the in-door wall which are liable to be rubbed against. Very pretty advanced exercises in the use of colour may be had by the use of stencils. The best account I know of their use is to be found in the article by Mr. Heywood Sumner, which is contained in a suggestive little volume entitled *Plain Handicrafts*, and which is well worth attention throughout. But we are straying rather beyond our immediate scope, and to carry the treatment of colour beyond the preparation of a small number of the most usually serviceable tints would demand a treatise to itself.

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CHAPTER VIII

BOXES

ALTHOUGH we have already spent some time in studying the construction of boxes, and have even given some attention to embellishing them with colour, with metal, or with carving, we have not yet mentioned the typical workmanlike method of making a box—the dovetail jointing of its four sides, which we may regard as the first step towards cabinet-making. And indeed there is no reason why the ambitious should not have dovetailed the boxes which were to be enriched with the metal angle plates; and certainly, if we were by way of teaching joinery, it might be our duty to insist upon this more excellent method from the first. But as it is, the interest for us of this, as of other joints, lies rather in understanding the reason of its general excellence as a workmanlike joint, which we shall best apprehend by experimenting with various forms of construction, rather than by drawing our examples from the practice of a single trade. In so doing we shall but be following the lead of teachers of arithmetic, who by no means confine their choice of sums to those

that actually occur in casting the ledgers of a single business.

Now the dovetail is a joint which is principally of use when the ends of pieces of wood have to be joined at right angles to their lengths; practical instructions for making it will be found in any book which treats of the actual handling of carpenters' tools. For joining the end of one piece of plank to the side of another it is of no practical use, but for end joints it is a very pretty

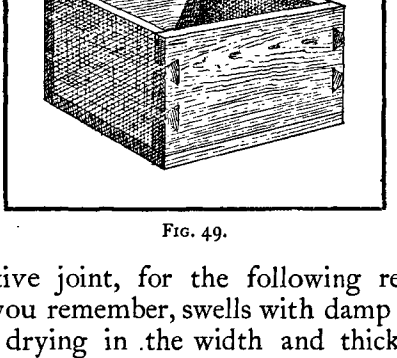

FIG. 49.

and effective joint, for the following reason:—wood, as you remember, swells with damp and contracts on drying in the width and thickness but not in the length of the plank; now as the grain is all one way with this joint, no swelling or shrinking will affect its tightness as both parts will work together. In the nailed box you will remember that the strength of the corners depended chiefly upon the thickness of the piece into which the nails were driven, and similarly it is obvious that the strength of a dovetail depends

finally on the thickness of the sides; while for any given thickness accuracy of fitting determines the strength.

Now we shall find as we go on that the main structure of very many works of wood is just that of a box, four pieces of wood dovetailed together at the corners, their keeping in shape being dependent upon the perfection of the work at the joint.

But supposing that we want to make a box

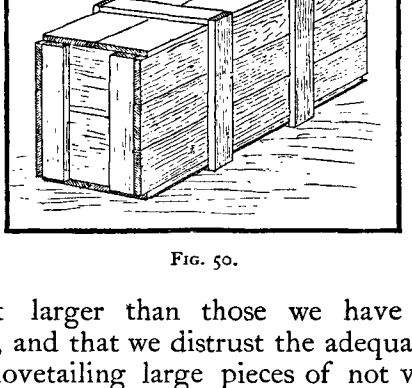

FIG. 50.

somewhat larger than those we have hitherto discussed, and that we distrust the adequacy of our skill in dovetailing large pieces of not very thick wood, what method lies open to us? I think that in that case we may find a large measure of practical science in the make of certain rough-looking and perhaps despised pieces of carpentry, packing-cases in fact. Of course a great many packing-cases are simply plain nailed boxes, such as we have already considered, but most of any size are constructed of rather thin boards nailed side by

side on to narrow slips at either end called ledges; and very considerable skill may be shown in the disposition of these ledges, which serve at once to unite the narrow plank into a wider board, and to give a sufficient bearing for the adjacent sides to be nailed to. Having prepared one pair of sides you can either nail the plank for the other pair direct to the ledges of the first pair, or you may fit them with their own independent ledges, and then nail the separately completed sides together. We have the further choice between putting the ledges inside or outside, or one in and one out at each corner; the sides also may have additional ledges at mid-length. We may cut them exactly to the width of the sides, or leave them projecting so as to receive the thickness of the lid and bottom; and you may be sure that a good workman has excellent reasons for his choice in any case, though perhaps he would not be able to explain them in very elegantly scientific phraseology. But however that may be, I hope that hereafter you will look at a packing-case with a trifle more respect than you have hitherto felt, and realise that very superior people need not be above learning various lessons from these humble constructions.

Let us consider the structure of the ordinary form of bookcase; what is it but a divided box set on end? Just as it was with our first rough boxes, if you make the shelves thick enough and they are not too long, you can nail the uprights directly to them, though this is, it is true, but a rough way of doing the job. Again, as in the packing-case, we can attain greater strength by using ledges, and if those for

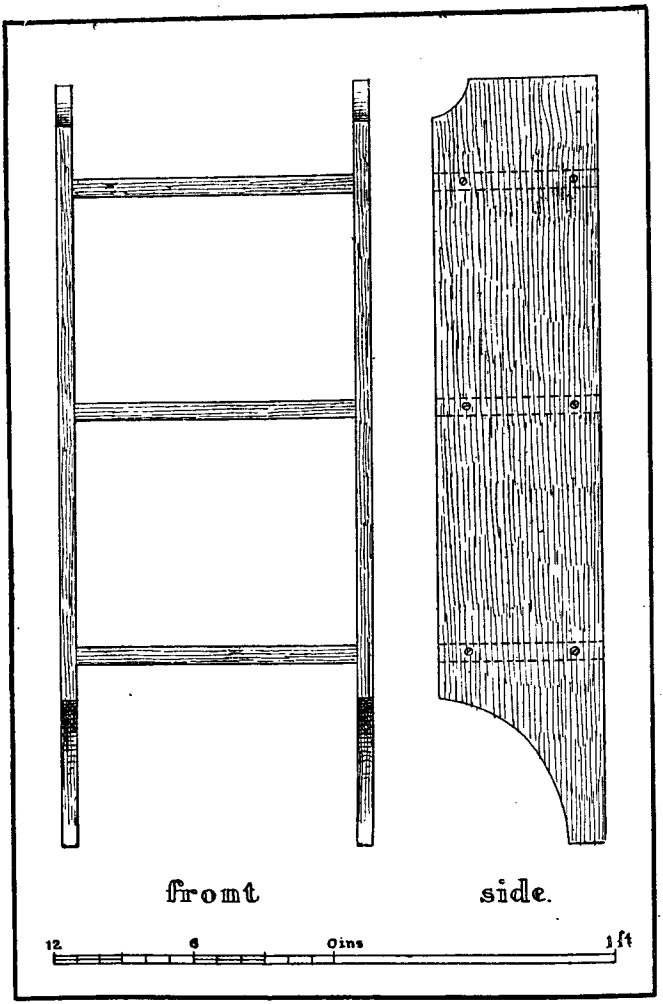

FIG. 51.

the top and bottom shelves are stout and planed truly square, we can make a good firm job with comparatively thin wood for the sides and shelves, by screwing the ledges to the shelves and the sides in turn to the ledges, after the shelf ends with ledges attached have been squared up truly with a plane. I cannot, it is true, say that this will make a very tidy looking affair, even if we improve it somewhat by working a hollow chamfer on the ledges and across their front ends as in Fig. 52. We might, of course, conceal these ends with the leather edgings that are used to keep the dust off the top edges of books, though they would be rather an extravagance on such a homely affair. We can, however, conceal them, and at the same time stiffen our structure, by carefully fitting in two thin slips of wood between the side pieces; the slips should be kept about $\frac{1}{4}$ inch from the face of the work; they may be straight, with the lower edge rounded off, or with a bead worked upon it, if a narrow bead plane say $\frac{3}{16}$ inch be available; though indeed it is not difficult, with the aid of glass-paper and plenty of care, to work a bead with a common screw head, the slot of which, touched up with a file, forms the cutting edge; the screw is driven nearly to the head into a small piece of wood which is worked up and down the edge so as to scratch a furrow at the desired distance from the edge; and this tool

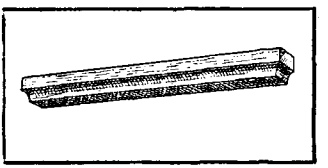

FIG. 52.

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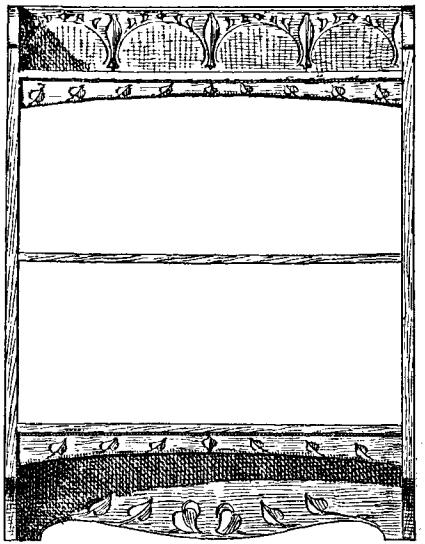
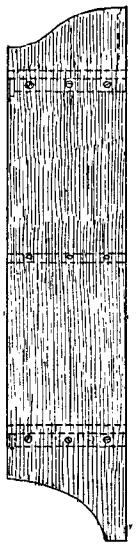


front



side

Scale of 12 9 6 3 0 2 feet

Fig. 53.

will follow round a curve which the regular plane will not. Beaded or not these pieces look well curved if the length be not too great, and they are obviously good places to put a little carving or other decoration if so your taste incline. Round-headed screws should be used for the sides, the holes being carefully lined out so as to look tidy when all is finished. Even so, however, there remains a sense of incompleteness about our design in the blank spaces between the ends of the sides, where they project above and below the shelves. Once more we shall find a remedy in fitting pieces lengthwise between them, and so completing the design in Fig. 53. The neatest way of fitting them, undoubtedly, is to cut them slightly longer than the space, and to form rebates in the sides to receive them, so that the end grain is hidden (Fig. 54). The easiest way is just to fit them in simply,

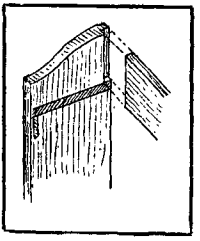


FIG. 54.

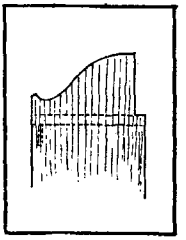


FIG. 55.

while a stronger if not so tidy a way is to notch the side pieces thus (Fig. 55), and nail or screw the back pieces right across. Though untidy, it is so much the strongest plan that it is worth while taking some thought to see if we cannot make it present-

able, in case we find it desirable at any time to avail ourselves of the stiffness it confers on the structure, to dispense with ledges, etc. A possible and easy way is to let the ends of the back pieces project about $\frac{3}{4}$ inch beyond the sides, and trim them with rounding notches, cut with a gouge, or some such rudimentary carving, and then utilise them as lugs through which to drive the supporting nails into the wall. Not a bad variation would be to let the upper piece project more boldly in a well-shaped ear with the nail put at the outer corner (Fig. 56). As to the thickness of the shelves, $\frac{1}{2}$ inch deal will do well for ordinary books up to a length of 20 inches or so, while $\frac{3}{4}$ inch will serve for nearly 3 feet, beyond which it is generally wiser to subdivide the shelves by upright divisions.

Now I want to direct attention to quite another method of finishing the tops of such sets of shelves, though still quite in the packing-case manner. Instead of prolonging the sides above the top shelf, you may cut them off square and make the top shelf to overhang an inch or more at either end, thus accommodating the ledges on the outside of the case.[1] Much that we have said as to the look of things applies as before; but if we also make the top board $1\frac{1}{2}$ inch wider, as well as overhanging the sides $1\frac{1}{2}$ inch at each end, and then continue the ledges across the front, we have the rudiments of a very important form, the simplest idea of a *cornice*, not this time borrowed from architecture, but an outgrowth of rudimentary cabinet-making. We must not now enter into the possible elaboration of

[1] See Fig. 69.

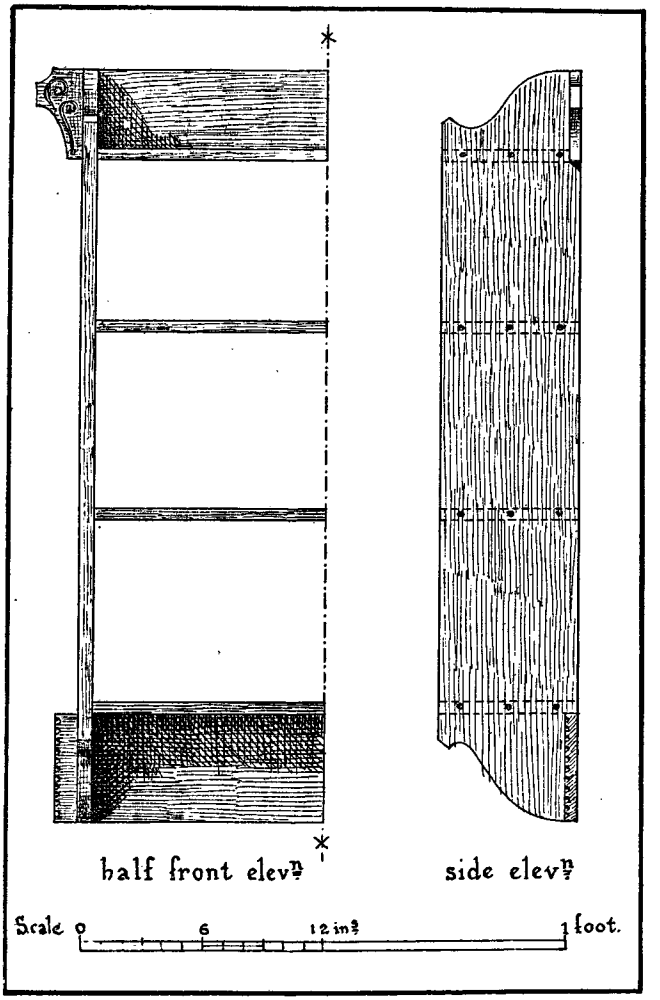


Fig. 56.

cornices, but even our perfectly plain one may look quite presentable if we contrive our thicknesses and our projections properly.

As to the books that a craftsman should have on his shelves, we may have something to say later on; for the present let us be satisfied with having developed the skeleton of a lidless box into a bookcase, and proceed to see what we can make

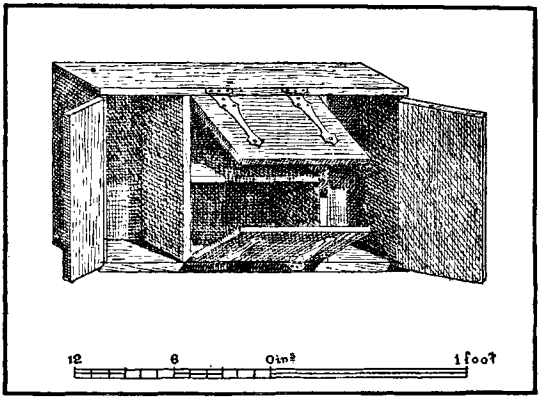


FIG. 57.

of a complete box with a hinged lid. You see at once that if you set such a box upon any of its four sides it becomes a cupboard or locker, and here is a cut of a nest of boxes, showing the four possible ways in which you may set them up, each of which has its appropriate uses (Fig. 57). All that we have found out in discussing the bookshelves still applies; what we have done is to add the lid or door, and, so far, the door is a plain piece of board, which indeed you may adorn as you please, and if

you please, while structurally it remains the same, practically limiting you to the width of 10½ to 11 inches which can be cut out of an ordinary deal plank. Now as you already know, our packing-case maker gets over the difficulty when he wants a wider lid very readily, by nailing several widths of stuff to the same cross ledges, and the like con-

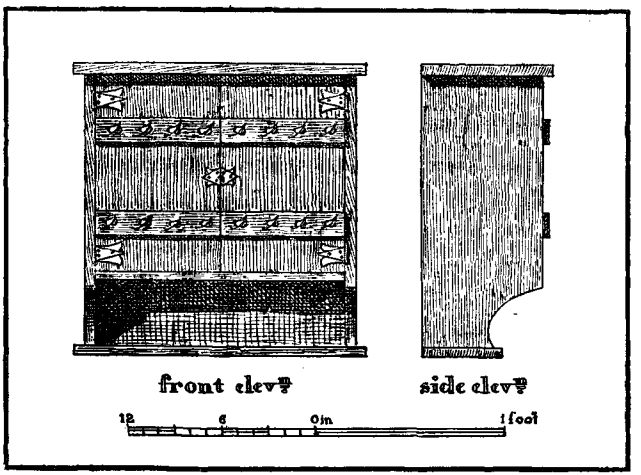


FIG. 58.

struction is familiar enough on a large scale in the ledged doors of outhouses. But though thus commonly associated with rough work, there is nothing inherently ugly in ledges; as with everything else, it is just a question of nice proportion and nice shaping.

Fig. 58 is a sketch of a little cupboard with a pair of doors which, though ledged, are narrow enough

to cut from single widths of plank. They are quite plain, except for a little ornament carved on the

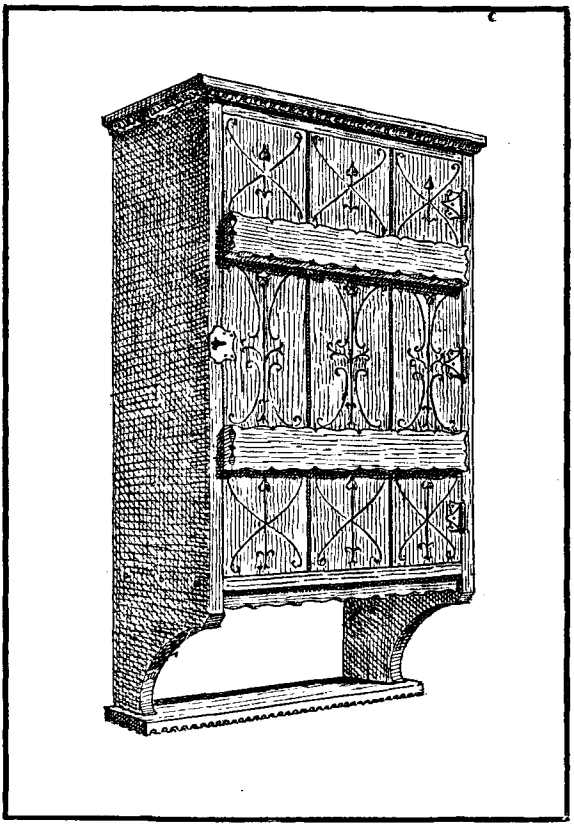


FIG. 59.

ledges, and for the hinges and fastenings, but that is sufficient. Fig. 59 shows a larger cupboard with a

single door, made of three strips of wood held together by ledges. The ledges are slightly carved, and the joints between the strips, as we cannot anyhow prevent their showing prominently, are accepted as the foundation lines of the design, and are joined up by the curved incised lines which form a simple but effective decoration. In the cupboard shown in Fig. 59, instead of a pair of doors, we might have preferred to make a door in one piece, and hinge

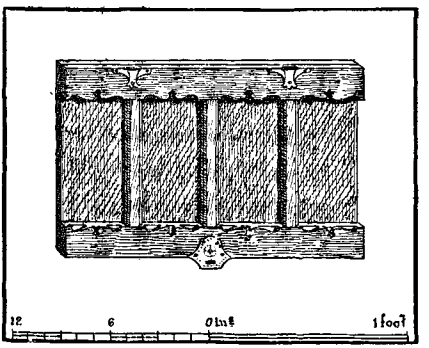


FIG. 60.

it at the top or bottom, so as to open as a *fall*. Our best plan, then, would be to put the ledges at the top and bottom, and we might cover the joints by narrow strips of wood, tacked on as shown in Fig. 60.

Now I propose to make an important forward step in construction, with the supposition that you desire to accommodate your books in a cupboard with a glass door, the better to protect them from dirt and dust. I imagine that the easiest way of

making such a door, is that sketched here (Fig. 61), in which, following the principle which has so often guided us, we nail two narrow slips to the carefully-squared ends of wider cross rails. On one side the hinges act as straps, further to secure the joint; and on the other similar straps serve also as stops to determine the closing of the door; inside strips of stout paper a little wider than the frame are glued all round; and on these the glass is laid, then the paper is turned up all round over the edges of the glass, glued and held down by weights till it is dry. Not the most elegant way of accomplishing the job, but I have seen things done worse in spite of greater pretence of correct workmanship, and it is better to be a maker of packing-cases, who knows what he is about, than to pretend to cabinet-making when you have not at command that accuracy of cut which makes their methods practicable. Nevertheless, we can make one step in advance without excessive difficulty, by making a rebate to receive the glass. For this purpose you must make the side strips, or *styles* as we ought to call them, $\frac{1}{4}$ inch wider than before; you have then to cut the rebate with a rebate plane

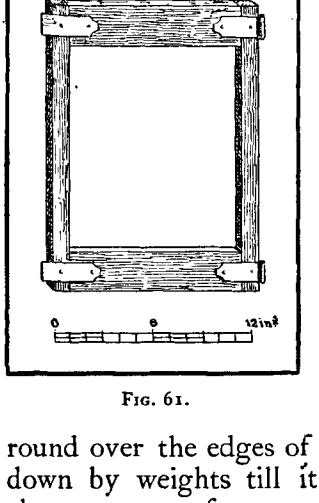


FIG. 61.

on all four sides alike, and to cut away the projecting $\frac{1}{4}$ of an inch from the styles where the ends of the cross rails will abut upon them. If you are very neat and tidy, I think that paper and glue

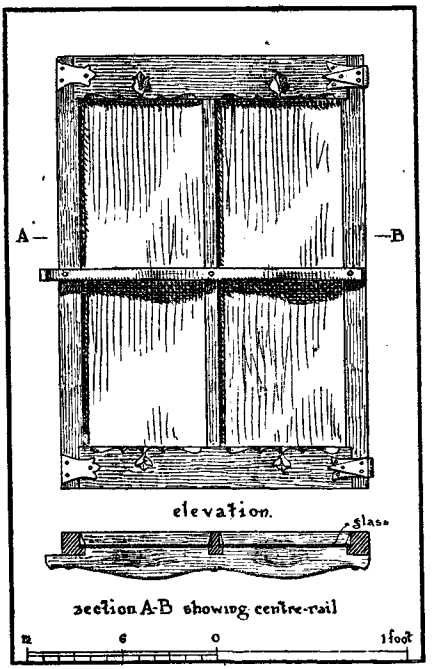


FIG. 62.

or paste are still the best way of fastening the glass in such a frame, but putty is now available, or thin strips of wood, which would be called beads, fixed into the rebate with fine brads. A single pane of glass does not look well if it exceeds quite

a small size, so Fig. 62 shows how, with similar manipulation, we may arrange a door with four glass panels. The additions necessary are, first the central rib which is rebated on both sides and notched to fit into the rebates of the top and bottom rails; thus making a two panel frame, which might be useful as it is in some cases, but which we further subdivide by the central cross rail. This we fit rather differently. There is no need to rebate it, as the pieces of glass may be allowed to butt against each other in the middle, and the joint can be made dust tight with a strip of glued paper or tape; thus we have only to notch out the rail to fit over the three uprights, so as to bring its inner edge level with the surface of the glass, and then we can secure it in position by fine screws passed into it from the back of the frame; and being set edgeways it will serve excellently to strengthen the door in that direction which in the mere process of making you will quickly discover to be the weakest. But having made it thus prominent, we must shape it the more carefully lest it offend the critical eye. I think the boldest way is the best, that is, to let it project well out, and then shape it so that it is convenient to handle in opening and shutting the door—rounding off the outer edges into a nice sweep, and hollowing out behind them with carving tools, so as to give finger-hold. The end away from the hinged style may project over as a stop on to the side of the cupboard, and if it shut between two screw eyes a pin passed through them and it will make a simple fastening. If for the glass you were to substitute

wooden panels, the structure, still depending for strength on the frame and not on the panels, would in principle be much the same as the framing which holds so large a place in the craft of joinery, but differing greatly in details of execution, since the greater skill of the trained artisan enables him to employ with speed and certainty methods of shaping and jointing the

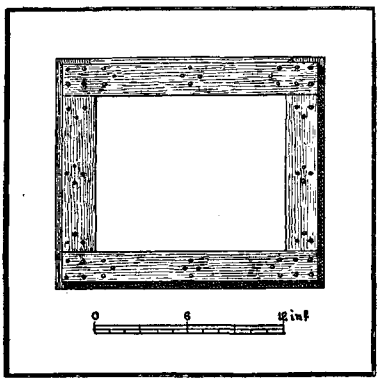


FIG. 63.

material, which in the hands of a beginner could only result in a botch, and the attempt to employ which would tend to obscure broad and general mechanical principles in the premature effort to grapple with the technological difficulties of a special craft.

From such framework as we have been discussing, to the framing of a picture or mirror, is an easy and natural transition; the frame in Fig. 61 would answer all the mechanical needs; but

before suggesting developments of this form, let us notice a method of making a frame, which, so far as the demands it makes for skill in execution, might more properly find a place in Chapter III. Say that we desire to make a frame for a picture, the sight size of which is 12″ × 10″;[1] we have only to prepare some strips of wood planed to a thickness of about $\frac{3}{8}$ inch and a width of 2 inches; we cut two of these, and square their ends to a length of 10 inches; two more we similarly finish to a length of 12″ + 4″ = 16″; these, placed together, leave an opening the sight size of the frame; a pair of 10″ + 4″ + $\frac{3}{4}$″ with a pair of 12$\frac{3}{4}$ inches long, give us the rebate size of the frame, and we have only to place the one set over the other in proper order, and to nail or glue them together to complete a frame which with tidily arranged brass nails would be pretty enough (Fig. 63). But by this time, no doubt, we are ambitious of higher things, and we can easily develop the rebated glass door into a sufficiently ornate frame by prolonging the side strips and shaping the top and bottom rails in some such way as is shown in Fig. 64, which is further enriched by the use of carving tools. This form answers well for upright pictures, but as the square is approached, and for yet wider pictures, it becomes less and less appropriate. We are thus rather forced back upon a combination between our most primitive construction and that last mentioned; we retain the rebated frame, but as the sides, to appear in good proportion, have now to be too wide to nail conveniently and

[1] 12″ a workshop notation for 12 inches.

firmly to the rails, we supplement them as in Figs. 65 and 66 with pieces which take the ornamental form of a cornice and a cill, and which overlap

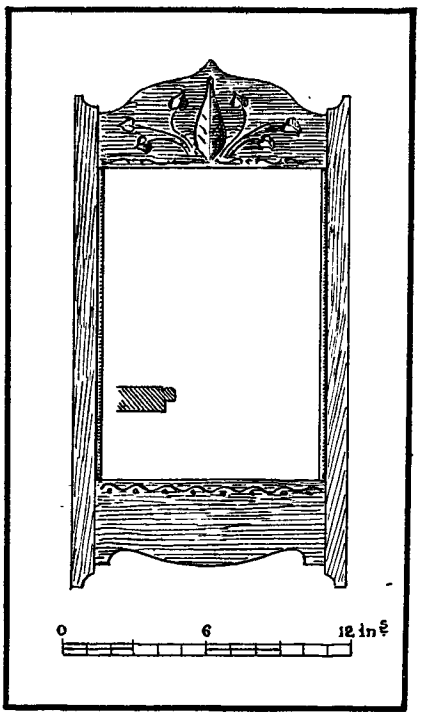


FIG. 64.

the junctions of the rails and styles; the rails themselves should be notched into the rebates of the styles, so that we thus get a very secure joint. Conformably to our established practice, having

added parts for a structural purpose, we proceed to make them as pretty as we can by carving or by

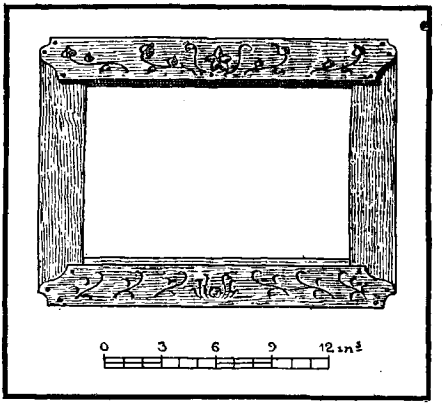


FIG. 65.

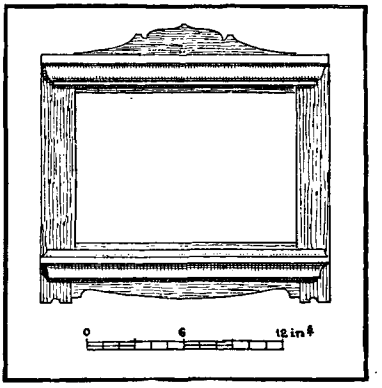


FIG. 66.

shaping them into mouldings, or in any other way that our taste and ingenuity may dictate. A

severer form, which some may prefer, we can make securely if our skill avails to cut a neat halved joint

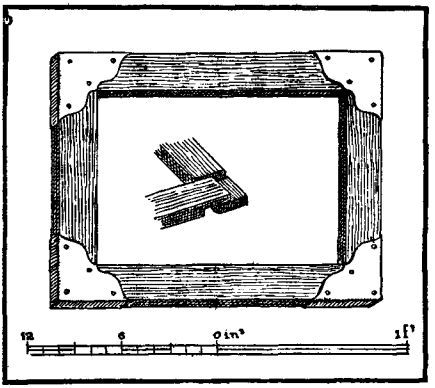


FIG. 67.

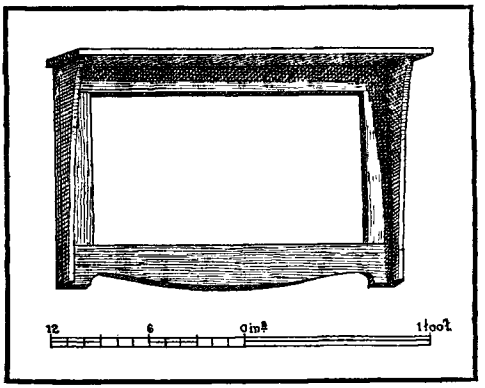


FIG. 68.

which we can at once strengthen and adorn by metal corner clamps, as in Fig. 67. One more shape

and it will be time to return to our almost forgotten boxes; Fig. 68 is in structure the same as Fig. 65, only we have cut the rails instead of the styles to the outside dimensions of the frame, and the overlapping pieces this time are set edge to the front and are shaped into upright brackets to carry the shelf or cornice at the top. It is a very beautiful form even in the utmost simplicity of execution here shown, and is besides worthy of attention as

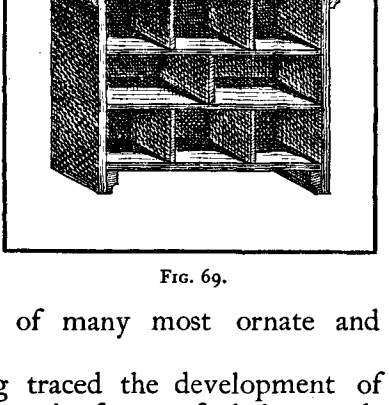


FIG. 69.

the germ of many most ornate and elaborate designs.

Having traced the development of a simple box into certain forms of shelves and cupboards, and being thereby led into a long digression as to the making of frames, we have now to go back a little upon our steps and point out how readily a series of shelves is, by the introduction of upright divisions, converted into a set of pigeon-holes, such as we see in shops filled with miscellaneous parcels, and often with tiers of cardboard boxes with lids—

a very convenient way of storing such things as papers. If, however, the boxes exactly fit the pigeon-holes we can do without the lids; we have, in fact, a chest of drawers (Fig. 70). Now the proper and accepted construction of a chest of drawers is a very elegant example of cabinet design, the result of the intelligent efforts of many generations of workers, admirably adapted to its purpose, but not lightly to be attempted by the unskilled. Still

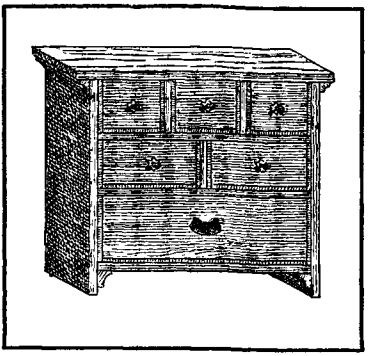


FIG. 70.

there are occasions when it is convenient for even the comparatively unskilled to put one lidless nailed box within another, the hollow of which it fits with all attainable exactness, so I will point out that as the strain of pulling out the drawer comes upon the end of the box it must be nailed in between the sides, so that the force of the pull has no tendency to draw the nails. If the drawer is small, the bottom may be nailed on just as in our earlier boxes, but if it is large and heavy, it is best

to diminish the friction of pulling it out and in by letting it run on the lower edges of the sides, which are for this purpose allowed to project below the bottom board. Such large drawers, however, are scarcely fit subjects for elementary practice, and any one who wants to make them had better make the nearest approach to the regulation articles

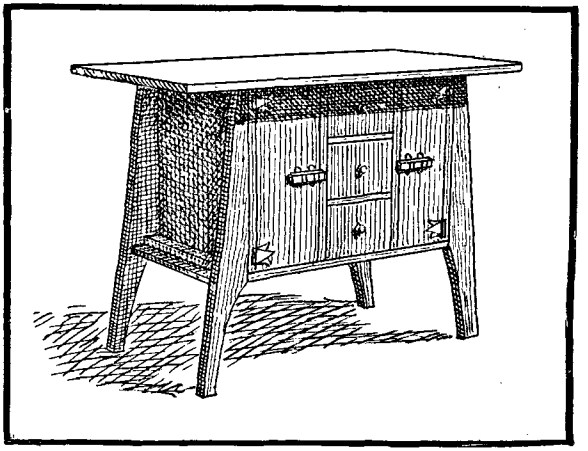


FIG. 71.

which his skill can attain. But for the sake of those who may desire to pursue these simple practices in after years, I add to this chapter a few suggestions, showing how these elementary forms develop into larger pieces of not unpleasing appearance. Those we have hitherto discussed have been intended to hang upon a wall. If they are to stand upon the floor our boxes will, for the

most part, require some sort of legs, and for the secure attachment of such legs we must supplement our inefficient skill at jointing by a prudent arrangement of parts. Supposing that we have made a chest something like that in Fig. 70, measuring about 18 inches high by 24 inches wide, and that we wish to set it on legs for use as a

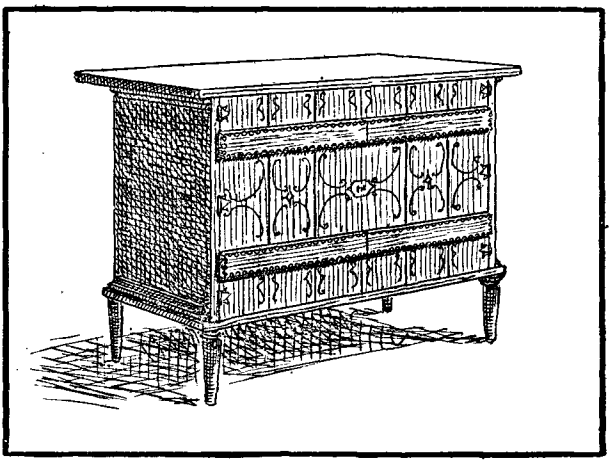


FIG. 72.

side table. Unless the experience of Chapter III. has been thrown away upon us, we shall soon recognise that the strongest way is to set the legs on the rake, so that we get the form shown in Fig. 71. If the height of the chest were more nearly that of the intended table we might set it upon turned feet as in Fig. 72, which shows an arrangement convenient for storing such things as drawings, etc. etc.,

the sides of the box being fitted with a number of ledges on which light ledged boards to carry the drawings slide in and out.

But there is no end to the variety of structures which can be built up in this manner, and which by a reasonable ingenuity can be made both solid and sightly. A full understanding of the strength and of the weakness of this primitive system will be an excellent foundation for a comprehension of the more refined and elaborate methods of the joiner and cabinet-makers, and of the means which they take to secure rigid jointing, availing themselves of the longitudinal strength of the timber while countervailing its weakness and perpetual shrinkage across the grain. And at all times it is a valuable exercise to discover for oneself in any branch of work in what ways the received trade methods are really superior to other possible arrangements, asking oneself the question, What is essentially necessary and what mere fashion? always remembering, however, that the chances are enormously in favour of there being a good and sufficient reason for existing practice.

CHAPTER IX

TABLES AND CHAIRS

We have discussed at great length the elements of one important form which largely prevails in wooden constructions of a movable sort. And, although we have taken care to adapt our designs to an assumed deficiency in executive skill, the mechanical principles involved hold good, whatever methods the workman employs—the stability or failure of his work depending upon his practical mastery of those principles. It is, therefore, an interesting study to follow out in detail the possible structural alternatives to any design—always bearing in mind the kind of use to which it is to be put, and the strains which it will have to resist, while trying to imagine at what point and under what circumstances it is likely to get broken.

We have now to proceed with an examination into the methods possible in structures which are not founded upon the box, or carcase as it is called in cabinet-makers' phrase. And these are, perhaps, even more instructive than the former, as they more nearly resemble those in use in much larger works, such as roofs and bridges, whether of wood or

iron. The fundamental principles have already been glanced at in the earlier pages of Chapter III.; and childish as the examples given may appear, they foreshadow the whole theory of framed construction. It is likely that when the special training of builders or engineers is concerned, those exercises would be followed by the construction of definite models to scale of such larger structures as roofs and the like, to be duly tested by loading

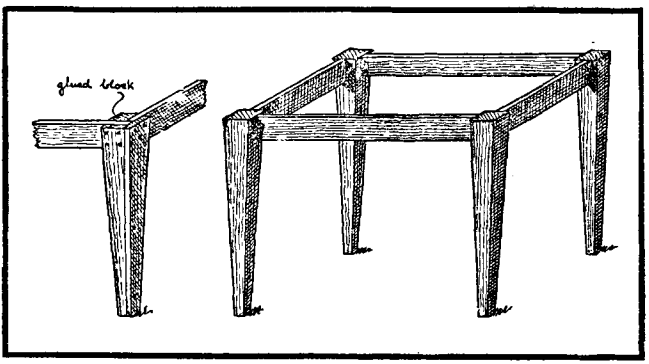


FIG. 73.

till they break under the pressure, which must of course be properly noted, and compared with other and calculated results. But for general use we find more serviceable examples among such domestic articles as chairs and tables, which soon display any constitutional weakness in the stress of daily use.

Now the ordinary four-legged table consists of a top supported by a frame, the four rails of which are tenoned into the tops of the legs; it is obvious

that, granting the excellence of the workmanship, the strength of the framing depends firstly upon the length and depth of the tenons, their lengths being limited by the size of the wood of which the legs are made. The size of the legs also limits the strength of the table in another way; for if they are too small they will bend and be shaky when the table is in use. But this tendency to bend is greatest at the top of the legs; and, therefore, it is common to taper the legs, leaving them thickest at top, both because the mortices into which the tenons of the rails are fitted require as much space as can be allowed them, and also because the bending strain diminishes towards the bottom. Now it is not impossible to carry out this structure by packing-case methods; and I have seen a very firm stand improvised out of rough materials much in this way. You cut two tapering (Fig. 73) boards for each leg and nail them together angle ways, and then screw the rails inside them. Probably you would find it best to strengthen the frame by glued blocks inside at the corners; but, any way, this arrangement has not much to recommend it as far as appearance goes, so we will try and design something better. You see of course that, apart from absolute collapse by the splintering of the legs, a table becomes unsteady by being pushed over one way or the other, as is shown in an exaggerated degree in the diagram (Fig. 74); it is, in fact, another case of the four-sided frame in

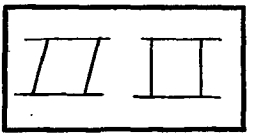


FIG. 74.

Chapter III. (Fig. 15), the floor being the equivalent of the fourth side. What we have to do is to arrange the several parts so as to resist this tendency to yield, with the least strain upon the joints, and without excess of material. I think that the accompanying figure (76) shows how this may be done, as far as regards a push across the table, in a way that is simple and shapely. To resist an endways push we must adopt other devices. The very strongest and lightest would be the cross-bracing shown in Fig. 76, but it is not pretty; and, with a little pains and attention to the exact shape of the parts, we can make the arrangement shown by Figs. 77, 78 answer all requirements; especially if we cut the lower rail slightly long, so as to throw the legs about an inch farther apart at the bottom than at the top. One ought not wholly to pass over the cross-legged type of table; a construction familiar in the common camp-stool, and also as a stand for a tray which is very useful when a table which can be folded up and stowed away is wanted. The common form of this is greatly improved in point of steadiness, by the addition of the cross-

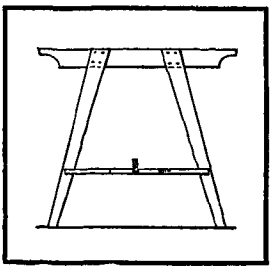


FIG. 75.

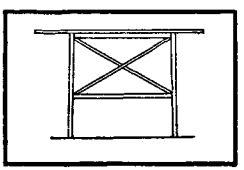


FIG. 76.

bracing shown (Fig. 79), to the one pair of legs, the other being hinged to the top. Though it is

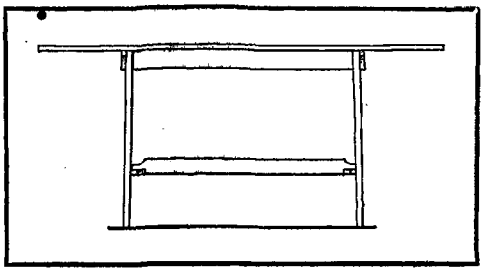


FIG. 77.

generally made with the legs in line with the length of the table it decidedly looks better, and

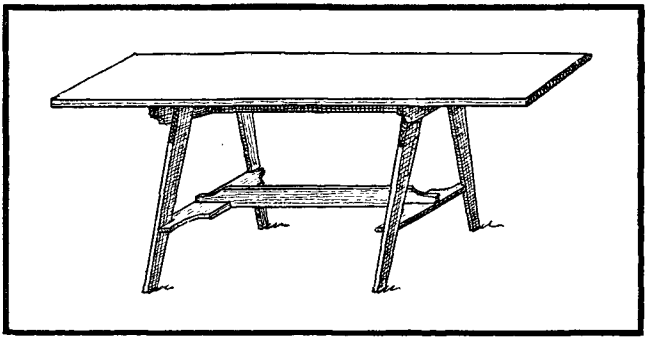


FIG. 78.

is certainly stronger when made as here sketched. For a square table, a different arrangement is desirable, though the inclined position of the legs

is still advantageous. The simplest plan is to make two cross-shaped frames, the upper being made of two pieces halved together and set edgeways, and the lower set flatways, and merely lapped; the four legs, tapered as before, are set

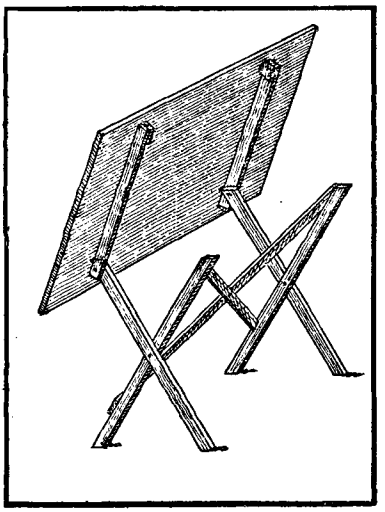


FIG. 79.

in notches cut in the lower cross, and are screwed or nailed to the upper.

In all these cases I have supposed the top to be made of narrow and rather thin boards set as close together as may be, and nailed to ledges on their under side. To make a proper table top requires great skill in the selection and handling of the material, and if the simple top described is not good enough, it is better to face it with paper or with

cloth, or other woven fabric, glued, pasted, or nailed, than to attempt to make a large glued-up top with inadequate capabilities. Some kinds of cardboard make excellent facing for desks or drawing boards,

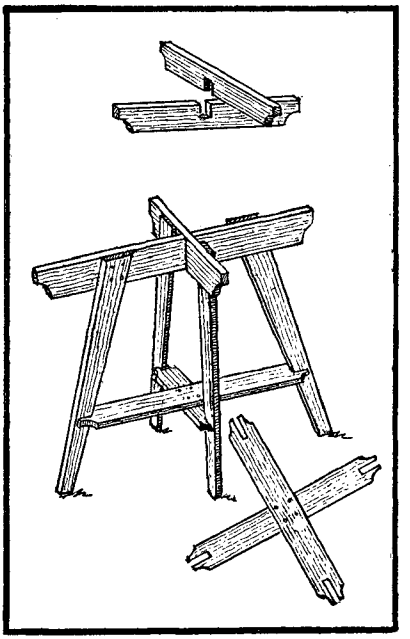


FIG. 80.

and indeed are often preferable to wood when a split or crack must by all means be avoided.

Chairs naturally follow tables in our thoughts; though once we pass beyond the simplicity of the camp-stool or the common bench, we shall find we have entered on a more difficult range of structures.

For the difficulty which we hinted at in the case of tables, that of getting sufficient strength at the corners where the two rails meet in the leg, is intensified in the case of chairs, which are subjected to very great strains, and, nevertheless, are usually required to be very lightly built.

We therefore find that chair-making is a highly specialised trade, often localised in particular districts, such as the neighbourhood of High Wycombe, which

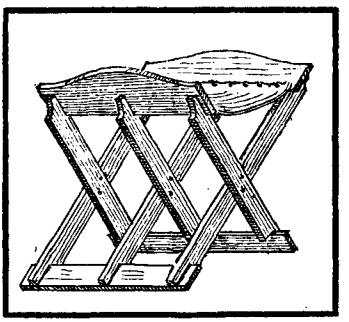


FIG. 81.

is the headquarters of the manufacture of various kinds of chair, the structure of which presents many points of difference from most other branches of woodwork. Basket-work, too, and cane which are good materials for certain kinds of chair are also the subjects of localised industries. Unluckily for us it is by no means easy to produce a comfortable, strong, and shapely chair on easy terms. It is true that a little rearrangement will make a pretty thing of a camp-stool; you have only to put an additional cross or two to the frame and vary the accepted

arrangement of the side rails thus (Fig. 81) and you get a very possible sort of seat. A very comfortable easy chair may also be made on sound engineering principles, of the packing-case order, and will look quite presentable if neatly finished off—though I admit that a certain amount of mortice work would make it still neater. As sketched, the back pieces and the front leg are

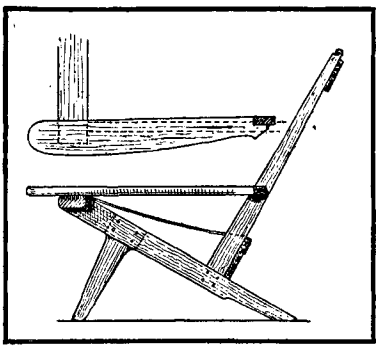


FIG. 82.

halved, glued and screwed into the long piece that forms the back foot; which is reinforced by a piece of wood, ½ inch thick, the ends of which extend an inch or two beyond the two halved joints and so strengthen the piece at its weakest points. The seat and back must be made of very strong canvas, with some prettier material to cover it. The front rail must be rounded on both upper edges, and is preferably slightly padded with horsehair or wool; the canvas of the seat is passed over it, and then nailed underneath with several rows of large-headed

tacks, and is similarly secured to the back rail. The canvas of the back is nailed down the front of the two side pieces of the back, so as to stand out clear in front of the back rail.

But you want to produce the equivalent of an ordinary upright chair, suitable for sitting at a table, and yet which can be made without the special skill of a chair-maker; and it must not be frightfully heavy or ugly. Now, before you set about it, I ask you to consider what sort of strain is put upon a chair when a substantial person tilts it back thus (Fig.

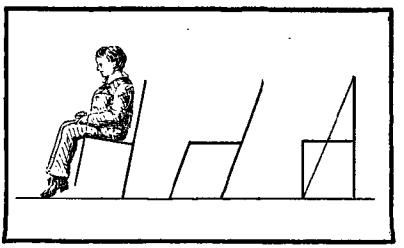


FIG. 83.

83), and how you propose to prevent it from at once assuming the second shape in the diagram! You will then realise what sort of workmanship and what sort of glue are required to make a durable chair. Of course we could cure the mischief once for all by a diagonal brace; but, somehow or other, no chair on this principle has ever proved pleasing to the eye; so other means must be sought. At best, I fear I shall have to ask you to make some mortice and tenon joints; but we will try to make them all of the easy sort, driven right through the flatways plank, and then we will

endeavour to make a chair that will not be very easy to tilt, that so it may escape destructive racking (Fig. 84). And to this end we will start with a firm foundation beginning with what we may call a sole-piece, a plate it would be called in large carpentry, which we must make of fairly thick stuff, $1\frac{1}{2}$ inch will do, and set flatways. Through this we can mortice the front and back legs ; and as we

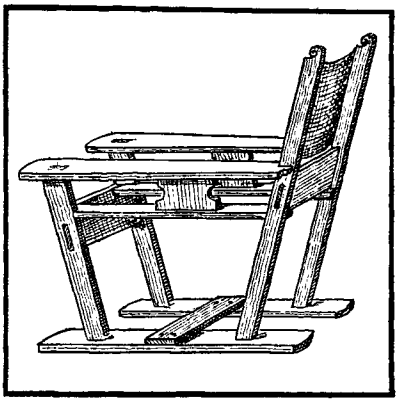


FIG. 84.

want the back to slope, for the sake of symmetry we set the front legs also on the rake. Then at the seat level each side we put a rail flatwise, notched out to fit between the legs ; and another a few inches above it, notched into the back, and projecting over the front leg ; this for further security, and to the bettering of the appearance of the chair, no less than for comfort as an arm rest ; since this time our chair is working out as something between the laziness of a lounge chair and the

severity of a stool. We have thus the two sides framed together which we can unite with cross ties. There will be one across from one sole-piece to the other; a wider one morticed through the front legs below the seat level; and one between the back legs at and above the seat level. The canvas seat will

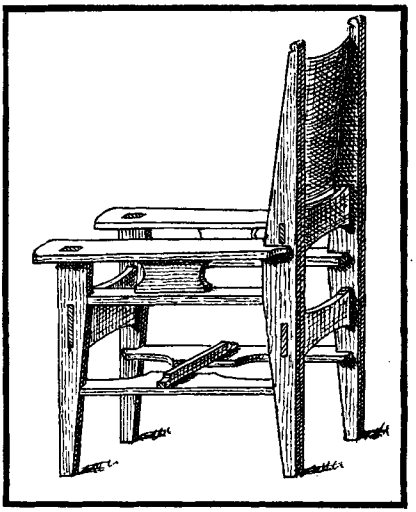


FIG. 85.

be tacked to the two side rails, and the back likewise will be nailed on face of the two back pieces. If we have so far succeeded, we shall be in a position to consider the possibility of making yet one step towards simplicity, by omitting the sole-piece—thus arriving at the upright form of chair in Fig. 85; which may be, I think, for the present, a last word on the subject of tables and chairs.

CHAPTER X

GARDEN CARPENTRY

It was accident, perhaps, that led us to a humble kind of garden appliance for a first start in handicraft; but now that we look back, after making some progress with the beginnings of skill, I cannot but regard it as a happy chance that brought us at the outset into contact with that, which, even in its humblest forms, must ever be a most precious beauty, alike in town and country—the garden. And though it may be that what I have now to tell of is not so strictly educational, in the narrower sense, as much that has gone before, in that it is less likely to be of general use at school, yet in the home workshop, which is, after all, among the best of schools, garden carpentry holds so honourable a place, that some further notice of a few of its possibilities cannot well be omitted.

I suppose that the growing network of railway lines has by now wholly overspread what used to present itself as a charming oasis in the desert to the passenger between Waterloo and Clapham Junction,—a low pantiled cottage, with whitewashed walls and bright green woodwork, standing in a

triangular garden plot, cultivated with exquisite care. But what excited my admiration most, after the bright clean colour, was the carpentry with which it was fitted—evidently, in its tasteful simplicity, the actual handiwork of the occupier. Two things especially I remember: one a sort of conservatory in front of the parlour window; and the other the porch, which spread out over the garden path with an open trellis roof, upon which a vine was trained. And, though this was an unusually successful instance, such efforts are by no means rare; yet they might be more frequent with advantage both to the owner and to the passer-by; beginning, on the smallest scale, with the miniature fence to the window sill, guarding a row of brightly ruddled flower-pots. But, pretty as the red pots are, there is no denying that plants do better if the pots be plunged in sand or mould contained in a box; for which purpose, though a box of the simplest type painted bright green will answer, yet we need not refuse ourselves the pleasure of something a little more ornamental. And the recollection that the window sill slopes to the front, while we want our box to stand level, suggests the elements of a decorative treatment. So we provide the box with a series of toes upon the front edge, which at once serves to maintain the level, and to keep the bottom from rotting with moisture pent up on the sill, the toes being formed by the ends of a row of ledges nailed to the front board; and, if we have first shaped out the lower edge, and run a bead along the top, we can complete the design with some simple carving, such as a sharp knife and gouge or

two will serve to execute (Fig. 86). Then, if we like to relieve the green colour of the paint, by picking out the uprights with white and yellow or red, who shall say, us nay? But perhaps a more effectual screen to the lower sash is desired than plants can

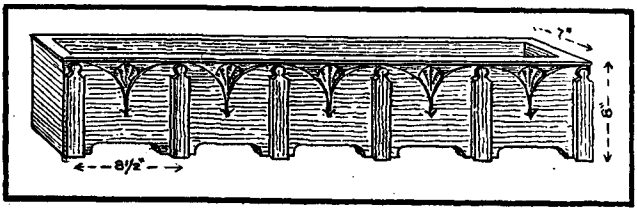


FIG. 86.

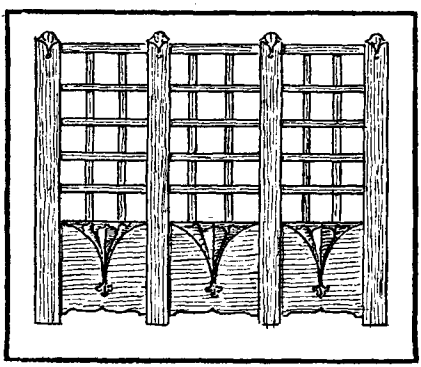


FIG. 87.

be relied upon to afford in permanence. What then do we do but carry the upright bars higher, and fill in between them with a trellis, making a fence behind which our plants may nestle; or for their better protection we may connect the tops of the posts with a single rail and glaze the spaces.

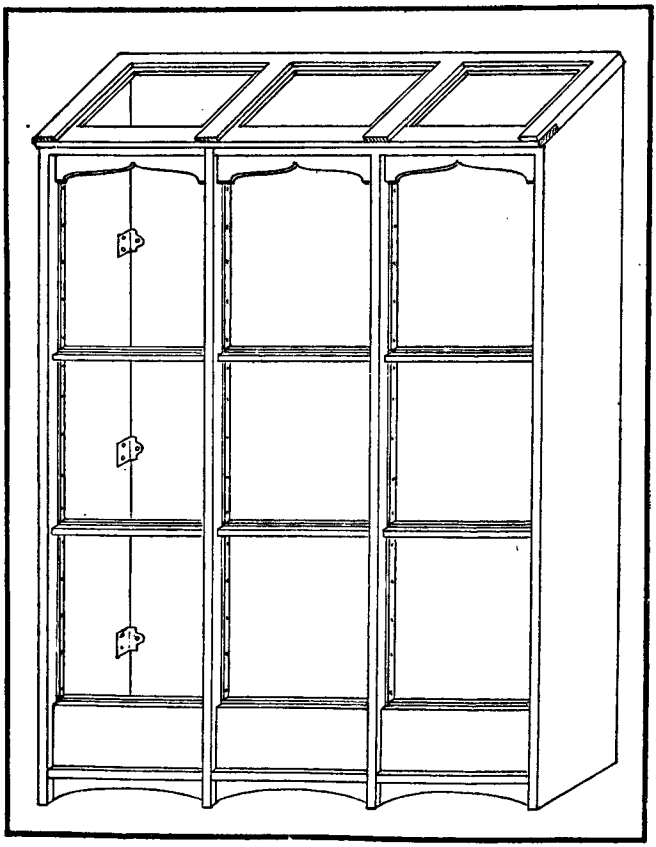


FIG. 88.

From this form it is but one step onward to the making of a plant case to fill the whole space of the lower sash, or even of the entire window. At its simplest, the two sides, the bottom, and the roof, make the four sides of a box. The sides are cut to the slope of the sill at bottom, and to the slant of the roof at top; and they are fixed to the outside beads of the sash frame by glass-plates and fine screws, though you can cut pieces of sheet tin to serve instead of the regular glass-plate. The roof is made just like our rebated picture frames in Chapter VIII., except that the front rail is kept thinner, and has no rebate, so that rain water can run freely off it; the edge of the glass rests on it, and may be held in place till the putty hardens by tacks driven along in front, or by small metal clips, as is the usual professional practice.

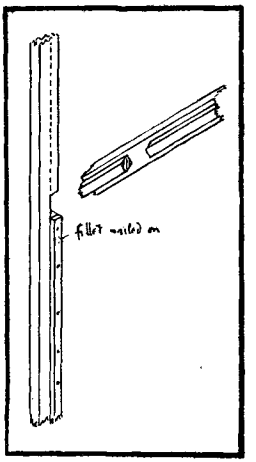


FIG. 89.

For the front you will require a bottom rail rebated for the glass; as also is the top rail which may measure $1\frac{1}{2}'' \times \frac{3}{4}''$; the uprights may be of the same stuff set edge to the front; while the cross rails should be $1'' \times \frac{3}{4}''$ rebated, and halved into the uprights thus (Fig. 89); then, instead of rebating the uprights, you can nail on thin slips or beads; and by so doing you will be able to make a much stronger structure than you could hope to make by

imitating the regulation ovolo-moulded sash-bar. Indeed, it is a pretty sight to watch a skilled joiner deftly and rapidly making the complicated looking joint, which is the correct way of putting a sash together; and when the bars are sufficient in substance, and numerous enough, it is the handsomest yet devised. But the plan described will serve an amateur for most sorts of greenhouse work in the upright parts. There are two simple bits of trimming that will improve the look of our job: arched braces between the uprights at top, and a corresponding shaping at the foot; and then it is done, except that we have forgotten an important practical point—ventilation. We may find that groups of centre-bit holes in the sides, with a sliding or other door to cover them in time of frost or snow, will suffice; but if our window be much exposed to baking sunshine, we must hinge the roof, so as to be able to open that upon occasion.

After the window sill, the next stage of garden expansion in towns is represented by the small flat roofs, which one often sees at the backs of town houses, over some projecting portion which does not rise to the full height of the rest. Sometimes you may see this covered by a greenhouse; at others it is converted into a tiny garden by a row of boxes round the parapet, and fenced with a wooden paling. But the prettiest plan is to carry up pairs of posts, at intervals of 3 feet or so along the fence, to a height of about 7 feet, with a group of four at the outer corners, and connect their tops by light rails running all round, across which trellis

bars, some 2 feet long, are nailed; and over them hardy climbing plants are trained to form an open screen to the little garden. In some parts of the

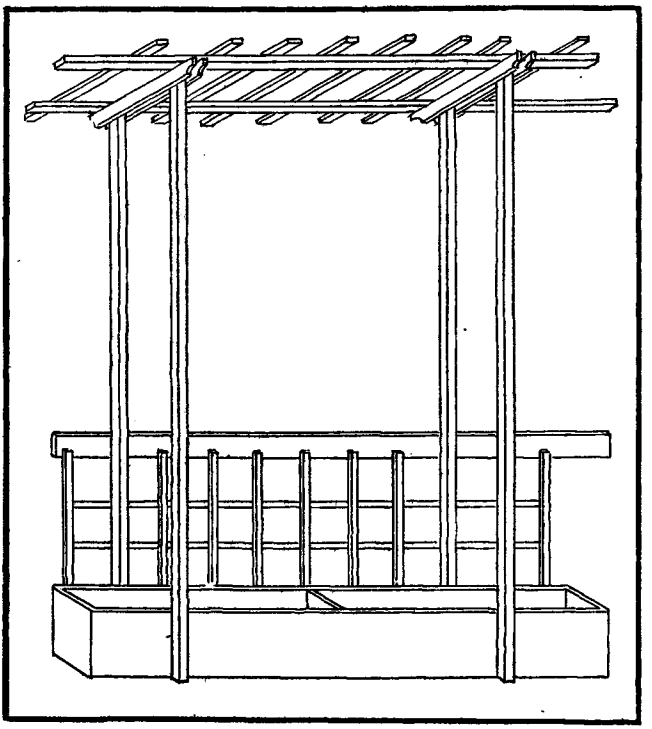


FIG. 90.

world this sort of fence, expanded, perchance, at some favourite angle into an arbour, is a very general surrounding to pleasure gardens of moderate size.

As we depart from the heart of the town, and the backyard expands increasingly into the semblance of a garden, we meet with fresh needs and fresh possibilities. The boxes of a former page expand into substantial tubs, braced together with ledges towards the upper part which are notched together where they cross, the projecting ends being rounded underneath for convenience in handling. In addition to actual gardeners' work, there is much handicraft

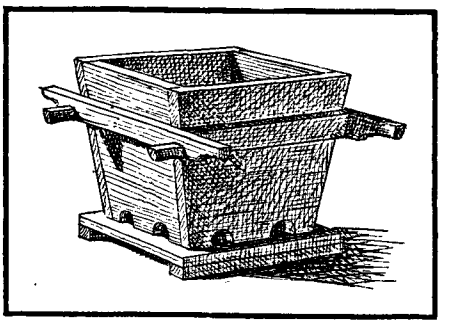


FIG. 91.

besides carpentry needed about such gardens, if they are to be kept seemly and fair. The paths have to be gravelled or laid with clean ballast, or paved in some way. And there is often a space near the house, when the garden lies to the north, on which nothing grows well; and it is best to mark this off from the rest, and pave it if possible; and where creepers will not thrive, the walls have to be kept bright with white or colour wash. Then there are the paths to edge off from the garden plots with stones, or tiles, or little wooden palisadings—

though in the country you can do beautifully with grass, or clipped box, or other green edgings. Arbours and sheds for tools, dovecots and hen-coops, and many more such things, we cannot even glance at now; but we ought to notice what is but an expansion of the trellis fence, for you will find that a sort of roof of light bars, crossing in squares of about 12 inches across, is, when overgrown with

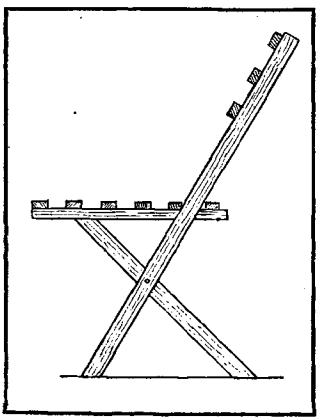


FIG. 92.

large-leaved climbing plants, a very pleasant shade and screen to sit beneath. Then we shall want seats, which may range from the simple plank nailed to rough posts driven into the ground, up to quite ornate pieces of joinery. The simplest form of framing for a garden seat is this (Fig. 92); the seat and back being made up of light battens slightly rounded on the upper side. It is not, however, a very pretty form, and in point of comfort leaves

room for improvement, for the seat and back ought to follow some such line as that at the top of Fig. 93. We can accomplish this, following our old method, somewhat as in Fig. 93—the main point being to get all prominent edges and corners well rounded off, especially the front edge; and let me not forget to say that, for out-door work, all

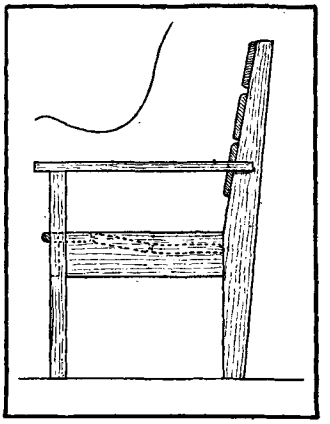


FIG. 93.

screws ought to be oiled, or otherwise greased, before being driven home.

Glass houses of many kinds would be an interesting theme to expatiate upon, the more so that they are often needlessly unattractive in appearance; but we are verging upon the utmost limits of our subject, and must be content for the present with an endeavour to make the modest hand-light which is so useful an aid to gardening. I suggest that you should make it with four corner-posts grooved

to take the glass as shown in the corner of Fig. 94; and that the pitch of the roof should be accommodated by shaping the top end rails pediment-wise, a thin piece of stuff being nailed on to support the glass, the lower edges of which will rest against the upper side rails; these must be notched at intervals to provide for the escape of the drip. A round bar through holes in the pediment at each end, and pinned there, will serve as a handle. The side-glass has to be slipped in from the bottom and kept in place by fillets screwed on to the bottom rails; and then, I think, we shall want nothing but a little paint, to complete a convenient and shapely device.

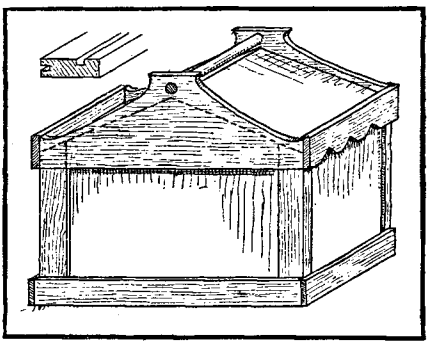


FIG. 94.

CHAPTER XI

RECAPITULATION

I TRUST that any one who has followed me thus far will have obtained at least an inkling of the simpler aspects of the processes of design; and that those who in addition to following the letter, have put their hands to the plough (among other tools), practically treading the furrow set forth for their edification, will close this little volume with a higher idea of the dignity of handicraft than is common with the scholar: will realise that the mechanics of industry are not mechanical in the baser sense, but full of fine philosophy: that, as a study, the articulation of joinery is not so far below that of speech as it seemed; while a day's work upon it may yield a solid satisfaction often denied to the best efforts of the verbal logician. Here we have been dealing with the science of handicraft in its cradle; but hereafter I hope to meet, as readers of more specialised dissertations, some of those who, with the aid of saw and chisel, have puzzled through this elementary logic of box and chair and table.

Bookcases, too, were among the structures we

made note of; and a word as to the books a craftsman should store therein was promised. Now books, as I know them, are of two kinds at least. Firstly, there are books which are literature, and of these there is little to say here, excepting a warning lest the pride of science lead to the despising of literature. And then there are books which are tools; one of which I have already mentioned once or twice, *Every Man his own Mechanic*, a useful common-sense work, a guide-book for the handy man, not highly scientific, and untrustworthy in matters of taste and design. Then there is a considerable choice of books dealing with joiners' tools and joints, such as Barter's *Woodwork*, handsomely printed and illustrated, but open to criticism on the score of design; *Workshop Notes* by T. H. Clark, which is good as far as it goes; and an American book, Goss's *Bench-work in Wood*, perhaps the most serviceable of those I know. Doubtless there are many more, besides the various works on Slojd, which might be useful to the teacher.

There is one great work on handicraft which one cannot ignore, though it is rather beyond the elementary teacher or scholar, Holtzapffel's *Turning and Mechanical Manipulation;* it certainly should be found in a college library. On the science of colour, there is Professor Church's excellent little volume, while on the practice of ornamental design Mr. Lewis Day's handbooks are standard. I know of no satisfactory practical work on architecture; but from the historical point of view Parker's *Concise Glossary of Architecture*, and *Introduction*

to Gothic Architecture are quite admirable as guides to the understanding of the glorious triumphs of handicraft. There is a little book called *Amateur Handicraft* dealing with various mechanical processes which always had a great charm for me; and on turning there are abundant treatises, that by James Lukin being a good one among the more simple. If your turn is for science the choice of books is superabundant, but provided you do not overtax the mental digestion a variety of reading has its advantages. As to wood-carving Miss Rowe's notes are far better than some more pretentious treatises, but this is, above all, a branch in which eyes steeped in a knowledge of natural form are the first conditions for doing good work. Unhappily, the periodicals devoted to these subjects are not worthy of their importance, though there is sometimes excellent matter to be found in the architectural papers, and in some of the monthlies. The little book I have already mentioned called *Plain Handicraft* almost crosses the line that bounds the class of mere tools, by reason of its style; and with this we leave the strict tools and pass to what, even in the craftsman's library, should be the larger class of literature. And we must name first the little volume of lectures by William Morris, who shares with Edward Burne-Jones the painter, and Philip Webb the architect, the foremost place among the designers of our time. And then there are all the wonderful writings of our modern prophet John Ruskin, bewilderingly diffuse, contradictory even, but intensely stimulating; and if I must choose among them, I would name *The Seven Lamps*

of Architecture, *A Joy for Ever*, and *Unto this Last*. Then we shall need as a corrective some acquaintance with the so-called orthodox economics; for instance, Marshall's *Economics of Industry*. Further, I will only name Carlyle's *Past and Present* as a sample of the doctrine of a man who has been called the apostle of work, and offer these questions as the test of your profit in reading: Does it stimulate thought? Does it stimulate action?

We often hear of technical education as a counterstroke to foreign competition, a vexed and difficult question, but of this there can be no doubt, that it is to the interest of each and all of us that every man should be efficient in his own degree, seeing that the return which each man gets for his labour must, whatever its monetary valuation, chiefly consist of the services of his fellows and the produce of their labour. Nor must we ever forget that education is concerned with life as well as livelihood; or lose sight of the aim to turn out worthy citizens of a famous state; not mere wage-winning machines, but men capable of enjoying the increased leisure which improving conditions of industry bid fair to confer upon us.

But with all this, in the case of individual schools, regard must be had to varying local circumstances: town differs from country, and one district from another in a thousand conditions of habit and of opportunity; and to ignore such predispositions would be to deprive school teaching of a large share of actuality. Sometimes it is

natural advantages, at others it is the exceptional talents of one or two leading minds that determine the direction of a flourishing industry; and while it cannot be the business of a school management as such to start village or urban industries, it may well be in the interest of individuals among them to encourage and foster such beginnings of industry. But it is important to bear in mind the distinction between production for the world's market and production for local use. Thus the local flower show stimulates horticulture, not with the object of competing with the flower farms of the Scilly Isles, but to enrich the village with the beauty of blossom, and to furnish the labourer's table with garden produce. Similarly, there is much handicraft that may be accomplished in any neighbourhood without thought of actual sale; the return to labour is not less real, because no money passes; nay, there is a strong antecedent probability that the direct interchange of services within a narrow circle will yield a better value than the wider risks of national and international commerce. Indeed, a word of warning is necessary against the idea occasionally entertained, that there exists an extensive market ready to absorb a vast production of amateurish wares, such as appear at bazaars; the fact being that all production for the great market demands special aptitude and training, applied with natural advantages of situation and the like. Most certainly is special talent requisite when a fresh industry has to be started in new surroundings with no advantages of long-established tradition and well-rooted connections. It is

in pushing such established industries that combined local effort is most wisely applied; to explore fresh fields is best left to individual enterprise.

The side of economics that most forcibly presents itself is apt to be competitive; we feel acutely the competition of our neighbours in ever-widening degree, and so we too easily lose sight of the more radical fact that on the prosperity of our neighbours our own is involved, the net return to every man's labour in great measure varying with the combined efficiency of his fellow-workers. Vainly we gather the materials for wealth from the ends of the earth, as the gains of adventurous commerce, if our people are too shiftless to convert them to their proper use. Surely it is time that in national education we corrected the clerkly bias of an old-world scholasticism which bids fair, in spite of racial instinct, to force upon us an unhandy generation, gaining a livelihood by labour which, however admirable in its endurance, is bounded by an all too narrow horizon shutting out the wider aspects of industry in relation to life and to society? This then will be our task, while retaining all that is best worth preservation in the older school, to offer the children of our land this which is new—a liberal education founded on right handicraft.

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